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United States
Environmental Protection
Agency

Office of
Emergency and
Remedial Response

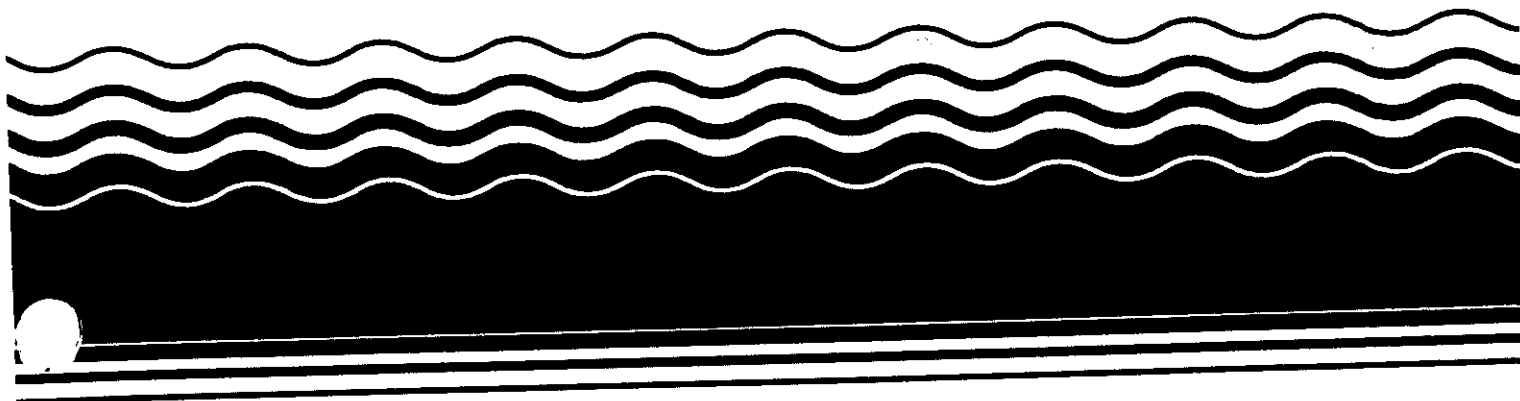
EPA/ROD/R05-92/223
September 1992
PB93-964129



Superfund Record of Decision:

H. Brown Company, MI

U.S. Environmental Protection Agency
Region 5, Library (PL-12J)
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Chicago, IL 60604-3590



NOTICE

The appendices listed in the index that are not found in this document have been removed at the request of the issuing agency. They contain material which supplement, but adds no further applicable information to the content of the document. All supplemental material is, however, contained in the administrative record for this site.

REPORT DOCUMENTATION PAGE		1. REPORT NO. EPA/ROD/R05-92/223	2	3. Recipient's Accession No.	
4. Title and Subtitle SUPERFUND RECORD OF DECISION H. Brown Company, MI First Remedial Action - Final				5. Report Date 09/30/92	
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				14.	
15. Supplementary Notes PB93-964129					
16. Abstract (Limit: 200 words) The H. Brown Company, Inc., site is a former landfill and battery reclamation facility in Walker, Kent County, Michigan. Land use in the area is predominantly recreational and industrial, with a wetland area located approximately at the northern half of a marshy area within the current eastern boundary of the site. In addition, part of the site lies within the 500- year flood plain of the Grand River. Before 1961, the site was an uncontrolled dump that received unknown types and quantities of waste. From 1961 to 1982, the owner reclaimed lead from wet-cell batteries. From 1961 and 1978, the owner reclaimed lead from wet-cell batteries and poured battery acid directly on the ground surface. The total volume of battery acid disposed of is estimated to be between 170,000 and 460,000 gallons. From 1978 until the owner ceased active reclamation activities in 1981 or 1982, battery acid was not drained to the ground; instead, it was routed to a stainless-steel catch pan and tank. In 1970, the state inspected the site and noticed acidic waters draining into a culvert that discharged into the Grand River. In 1978, the state sampled wastewater at the facility and found elevated levels of lead, copper, and nickel. EPA became involved with the site in the early 1980's and sampling of surface water from the culvert leading to the Grand River (See Attached Page)					
17. Document Analysis a. Descriptors Record of Decision - H. Brown Company, MI First Remedial Action - Final Contaminated Media: soil, sediment, debris, gw, sw, air Key Contaminants: VOCs (benzene, toluene, xylenes), other organics (PAHs, PCBs, pesticides, phenols), metals (arsenic, chromium, lead) b. Identifiers/Open-Ended Terms c. COSATI Field/Group					
18. Availability Statement		19. Security Class (This Report) None		21. No. of Pages 82	
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EPA/ROD/R05-92/223

H. Brown Company, MI

First Remedial Action - Final

Abstract (Continued)

indicated elevated levels of chromium and lead. In 1989, the Agency for Toxic Substances and Disease Registry and the state investigated the site and determined that the site posed a risk to onsite workers and the community. In response to an EPA-issued unilateral administrative order to 10 PRPs in April 1991, the owner's widow and the H. Brown Company erected a fence and performed limited air monitoring around the site. This ROD addresses the final remedy for the site. The primary contaminants of concern affecting the soil, sediment, debris (battery casings), ground water, surface water, and air are VOCs, including benzene, toluene, and xylenes; other organics, including PAHs, PCBs, pesticides, and phenols; and metals, including arsenic, chromium, and lead.

The selected remedial action for this site includes demolishing onsite buildings to allow cleanup of contaminated soil beneath structures, and disposing of the debris in an onsite or offsite landfill; onsite decontamination of buildings not requiring demolition; consolidating contaminated surface soil onsite; treating an estimated 180,000 cubic yards of soil, sediments, and battery chips onsite using in-situ solidification/stabilization; constructing a containment wall around the treated soil, sediment, and debris, and covering the solidified material using a multi-layer cap; extracting contaminated ground water from the shallow aquifer beneath the site; treating collected ground water and surface water onsite using aeration, filtration, carbon adsorption, and ion exchange, prior to onsite discharge to the Grand River; conducting additional studies to further define the extent of contamination in the intermediate and bedrock aquifers; monitoring ground water and surface water; and implementing institutional controls including deed and ground water use restrictions, and site access restrictions such as fencing. The estimated present worth cost for this remedial action is \$15,000,000, which includes an annual O&M cost of \$220,000 for 2-3 years.

PERFORMANCE STANDARDS OR GOALS:

Chemical-specific soil clean-up goals are based on site risks, state ARARs, or background levels and include PCBs 1 mg/kg (state); arsenic 6.6 mg/kg (background); lead 5 mg/kg (state). Chemical-specific ground water clean-up goals include benzene 1 ug/l (state); arsenic 17.9 ug/l (state); and lead 1,423 ug/l (background).

United States Environmental Protection Agency

**Record of Decision
H. Brown Co., Inc. Site
Walker, Michigan**

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**Declaration
Selected Remedial Alternative
for the
H. Brown Co., Inc. Site
Walker, Michigan**

Site Name and Location

H. Brown Co., Inc. Site
2200 Turner Ave., N.W.
Walker, Michigan 49504

Statement of Basis and Purpose

This decision document presents the selected remedial action for the H. Brown Co., Inc. site, in Walker, Michigan, which was chosen in accordance with the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision document explains the factual and legal basis for selecting the remedy for this site. The information supporting this remedial action decision is contained in the administrative record for this site.

Assessment of the site

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare, or the environment.

Description of the Selected Remedy

The selected remedy is the final remedy for the site. The remedy addresses the threats posed by principal threat wastes and contaminated groundwater at the site. Principal threat wastes are defined as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present significant risk to human health or the environment should exposure occur.

The major components of the selected remedy include the following:

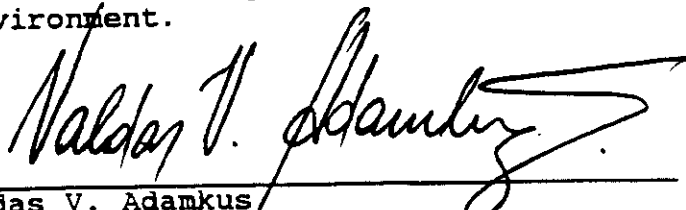
- Demolishing buildings to allow cleanup of contaminated soil beneath the structures, and disposal of the debris on-site or in an appropriate off-site landfill.

- Consolidating contaminated surface soil in the area where subsurface soil cleanup will be required.
- Solidifying/stabilizing, in place, contaminated surface and subsurface soil and sediments in a cement-like form.
- Placing a multilayer cap over the solidified/stabilized soil sufficient to meet the requirements of Michigan's Act 64.
- Surrounding the solidified/stabilized soil with a containment wall.
- Collecting, treating and discharging to the surface water all groundwater and surface water associated with construction.
- Installing additional wells to further define the condition of the intermediate and deep aquifers. This information will be used to determine what, if any, remediation of those aquifers needs to take place. These wells, along with other wells at the site, will be used to monitor the effectiveness of the remedy.
- Restricting the use of the land and the groundwater.
- Maintaining a fence around the site to prevent access.

Declaration of Statutory Determinations

The selected remedy is protective of human health and the environment, complies with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. The remedy utilizes permanent solutions and alternative treatment (or resource recovery) technologies, to the maximum extent practicable, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element.

Because this remedy will result in hazardous substances remaining on-site above health-based levels, a review will be conducted every five years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.


 Valdas V. Adamkus
 Regional Administrator

9/30/92.
 Date

State of Michigan: Letter of Concurrence

NATURAL RESOURCES
COMMISSION

LARRY DEVUYST
PAUL EISELE
GORDON E. GUYER
JAMES P. HILL
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O. STEWART MYERS
JOEY M. SPANO



JOHN ENGLER, Governor

DEPARTMENT OF NATURAL RESOURCES

Stevens T. Mason Building, P.O. Box 30078, Lansing, MI 48909

ROLAND HARMES, Director

September 30, 1992

Mr. Valdas V. Adamkus, R-19J
Administrator, Region 5
U.S. Environmental Protection Agency
77 West Jackson Boulevard
Chicago, Illinois 60604-3590

Dear Mr. Adamkus:

The Michigan Department of Natural Resources (MDNR), on behalf of the State of Michigan, has reviewed the draft Record of Decision (ROD) for the H. Brown Co., Inc., Superfund site in Walker, Kent County, Michigan, which we received on September 10, 1992. We are pleased to inform you that we concur with the remedy outlined in the draft ROD for this site.

The major components of this remedy include:

- * Demolishing buildings to allow cleanup of contaminated soil beneath the structures and disposal of the debris on site or in an appropriate off-site landfill.
- * Consolidating contaminated surface soil to the area where subsurface soil cleanup will be required.
- * Solidifying, in place, contaminated surface and subsurface soil and sediments in a cement-like form.
- * Placing a multilayer cap over the solidified soil to inhibit infiltration of precipitation through the solidified mass and to protect it from freeze thaw conditions. At a minimum, the cap would meet the Hazardous Waste Management Act, 1979 PA 64, as amended, requirements, including:
 - three feet of compacted clay,
 - a layer of compacted soil to protect the cap from frost,
 - a drainage layer, and
 - a vegetated top soil layer.
- * Surrounding the solidified soil with a containment wall.

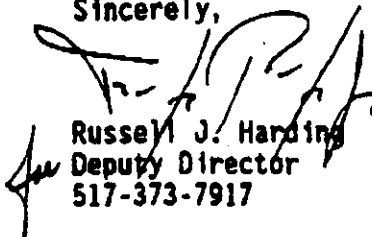
September 30, 1992

- * Collecting, treating and discharging groundwater and surface water to the Grand River.
- * Installing additional wells to further define the condition of the intermediate and deep aquifers. This information will be used to determine what, if any, remediation of those aquifers needs to take place. These wells, along with other wells at the site, will be used to monitor the effectiveness of the remedy.
- * Restricting the use of the land and the groundwater.
- * Maintaining a fence around the site to prevent access.

The State of Michigan also generally concurs with the analysis of legally applicable or relevant and appropriate requirements contained in the Statutory Determinations section of the ROD. Due to the pervasive organic and inorganic soil and groundwater contamination in the vicinity of the site which will remain unaddressed, the State considers this to be an interim action under the Michigan Environmental Response Act, 1982 PA 307, as amended. This pervasive contamination appears to be due to historical landfilling practices in this vicinity and not the result of activities at the H. Brown site.

We look forward to implementation of the remedy for this site.

Sincerely,


Russell J. Harding
Deputy Director
517-373-7917

cc: Mr. James Mayka, EPA
Mr. Timothy Prendiville, EPA
Mr. Alan J. Howard, MDNR
Mr. William Bradford, MDNR
Ms. Claudia Kerbawy, MDNR
Mr. Jim Myers/H. Brown File (J2)

Decision Summary for the Record of Decision

1. Site Name, Location, and Description

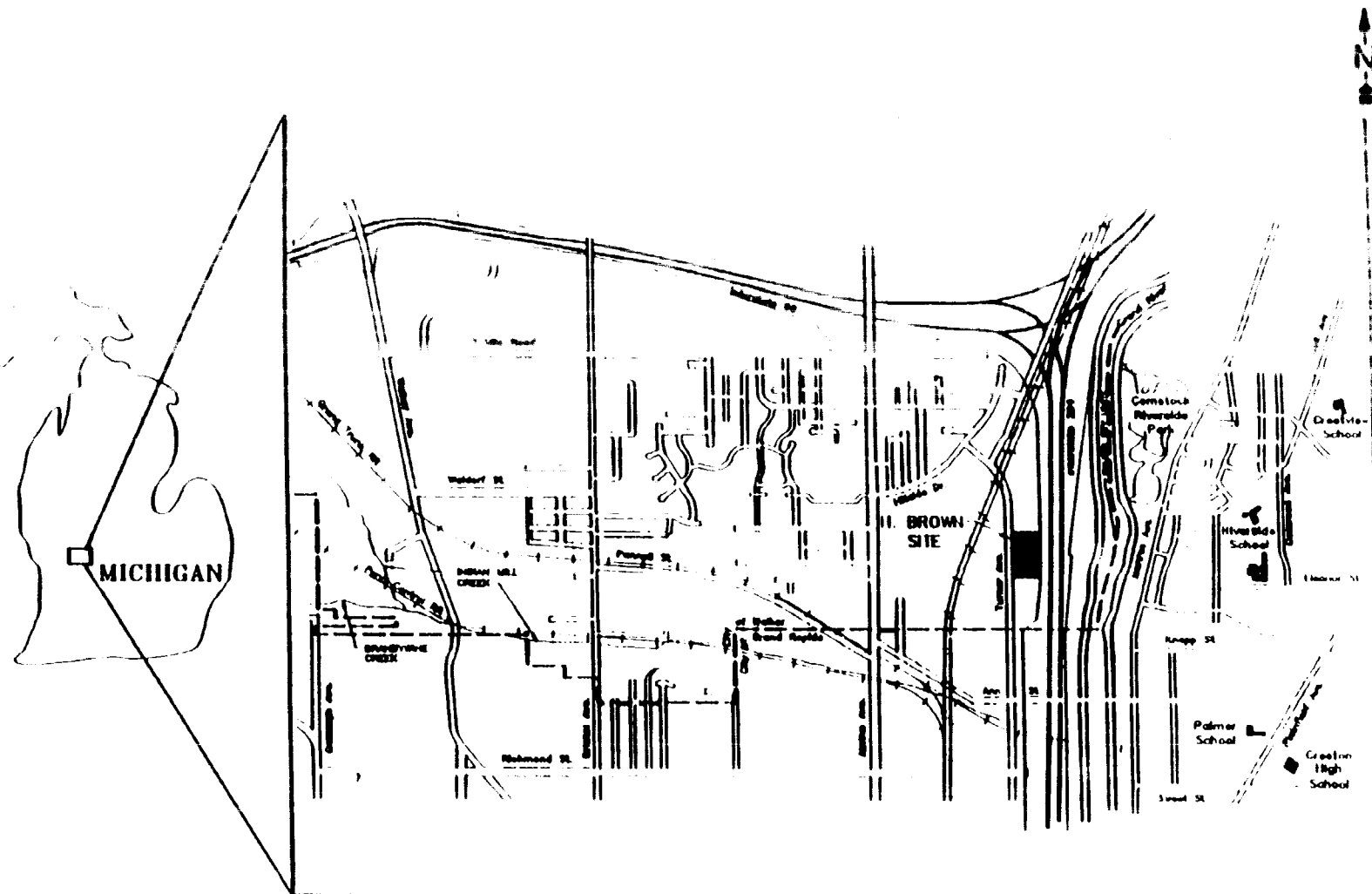
The H. Brown Co., Inc. site is located generally near 2200 Turner Avenue, N.W. in the City of Walker, Kent County, Michigan. Figure 1 is a site location plan and Figure 3 is a diagram of the site.

The H. Brown site is located in a light industrial area in Walker, in south central Michigan. A Grand Rapids city park is located east of US-131. Further to the east of the park, approximately 1,000 feet from the site, lies the Grand River. The site is roughly bounded by US-131 on the east and Turner Avenue on the west, but includes one area to the west of Turner Avenue. The site also includes Zenith Auto Parts to the north and Abbott Auto Parts (formerly Turner Auto Parts) to the south. The site is roughly bounded by Zenith Auto Parts on the north, southbound US-131 on the east, Abbott Auto Parts on the south, and Turner Avenue on the west. The site includes the following components (see Figure 3):

- Areas with surface soil contaminated with 500 parts per million (ppm) or more of lead;
- An unnamed drainage ditch east of Zenith Auto Parts;
- A drainage ditch named Cogswell Drain located near the southern boundary of Keizer Equipment Company;
- The storm sewer on Turner Avenue, between Zenith Auto Parts and Cogswell Drain;
- Approximately the northern half of a marshy area within (1) the current, eastern boundary of H. Brown, (2) southbound US-131, (3) Cogswell Drain, and (4) the unnamed drain east of Zenith Auto Parts. This area is referred to as the "wetland" throughout this document.

The general area of the site was once used as a landfill that received unknown types and quantities of waste. The boundaries of the landfill are not well defined, but they may extend beyond the boundaries of industries surrounding H. Brown.

Figure 1



LEGEND

- Railroad
- Interstate Highway
- Municipal Boundary
- Approximate Location of H. Brown Site

1000' 500' 0 1000' 2000'
SCALE: 1" = 2000'

H. BROWN SITE
WALKER, MICHIGAN

FIGURE 1.1

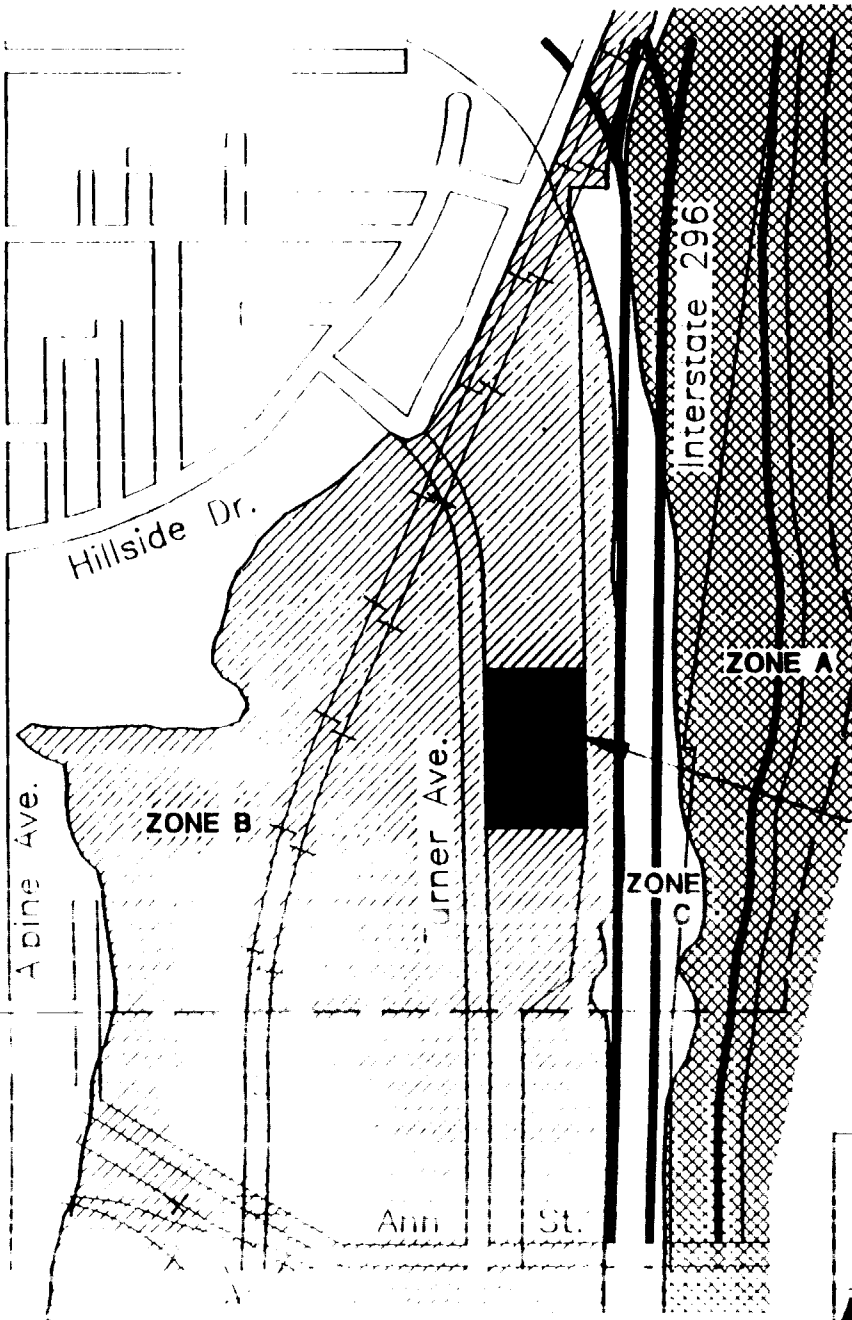
H. BROWN SITE LOCATION

PMC ENVIRONMENTAL MANAGEMENT

Figure 2

3-4

CITY OF WALKER
CITY OF GRAND RAPIDS



LEGEND

- ZONE A** AREA OF 100-YEAR FLOOD
- ZONE B** AREA BETWEEN LIMITS OF THE 100-YEAR AND 500-YEAR FLOOD
- ZONE C** AREA OF MINIMAL FLOODING

H. BROWN SITE

500' 0 500' 1,000'
SCALE: 1" = 1,000'

H. BROWN SITE
WALKER, MICHIGAN

FIGURE 3-2

FLOOD PLAIN MAP

PMC

Figure 3

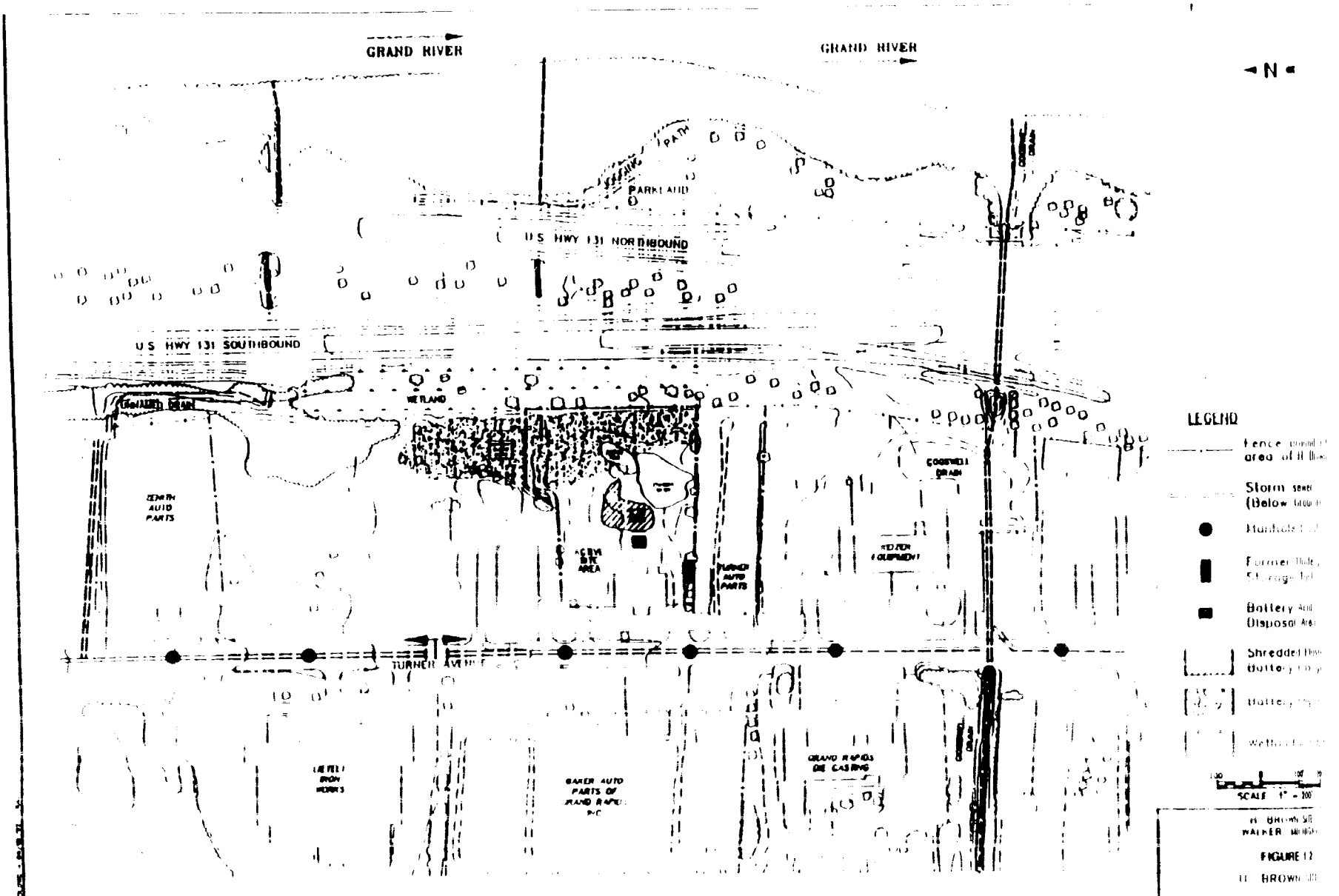


FIGURE 12

H. BROWN JR.

2. Site History and Enforcement Activities

Before 1961, a large area, including the site, was an uncontrolled dump. Herman Brown (now deceased) owned most of the area now called the H. Brown site. From 1960 to 1962 Mr. Brown leased portions of his property to the City of Grand Rapids on a contingent basis for landfilling purposes. This contingency never developed, and during the time of Mr. Brown's operations, no landfilling occurred. No documentation is available regarding the amounts and types of hazardous substances, if any, or the parties who may have disposed of waste in this landfill area.

Between 1961 and approximately 1982, H. Brown reclaimed lead from wet-cell batteries. Battery reclamation operations were not limited to the fenced portion of the site. Such operations probably extended north, south, and east of the fenced portion of H. Brown.

From 1961 to 1978, battery acid was poured directly on the ground surface of an area measuring approximately 25 by 50 feet. This area housed a battery shredder. The battery acid was drained directly to the ground before shredding the batteries. EPA believes that the acid was contaminated with heavy metals. The total volume of battery acid disposed of in this area is estimated to be between 170,000 and 460,000 gallons. During the early years of operation, battery reclaiming activities may not have been limited to the 25-by 50-foot area. Some battery casings may have been broken during storage elsewhere on the site and then hauled to the battery shredder for further processing. After 1978, battery acid was not drained to the ground; instead, it was routed to a stainless-steel catch pan and tank. H. Brown ceased active reclamation, including battery shredding, in 1981 or 1982. From that date to the present the operation accepted scrap nonferrous metals that are sold to off-site purchasers.

Before 1985, MDNR considered H. Brown to be a small-quantity generator of hazardous waste. The facility no longer reclaims batteries or generates hazardous waste.

MDNR inspected H. Brown several times during the 1970s. In 1970, MDNR noted acidic waters draining into a culvert that discharged to the Grand River. In 1978, MDNR sampled wastewater ponded at the facility and found elevated levels of lead (3.9 parts per billion (ppb)), copper (22 ppm), and nickel (2.6 ppm).

In the early 1980s, U.S. EPA became involved with the site. The site was inspected in 1984 as a potential hazardous waste site. Sampling of surface water from the culvert leading to the Grand River indicated elevated levels of chromium (198 ppm) and lead (1.4 ppm) and an acidic pH that may have been attributable to the site operations. Subsequently, the site received a Hazard Ranking System score of 39.88 and was proposed for listing on the National

Priorities List (NPL) on March 29, 1985. The site was designated a Superfund site and placed on the NPL on June 10, 1986.

On September 28, 1987, U.S. EPA began negotiations with a group of potentially responsible parties (PRPs) for performance of the RI/FS. On March 4, 1988, negotiations were concluded without resolution because the Agency did not receive a good faith offer.

In November 1988, U.S. EPA began the RI/FS at the site. After preliminary investigations at the site detected high levels of lead in surface soil, U.S. EPA informed the Agency for Toxic Substance and Disease Registry (ATSDR) of the potential for threat to public health. ATSDR and MDNR's Division of Public Health investigated the site in August 1989. On the basis of MDNR's findings, ATSDR determined that the site may pose a risk to on-site workers and the community.

On April 12, 1991, U.S. EPA issued a Unilateral Administrative Order (UAO) to ten PRPs. The UAO required that those parties erect a fence around the entire site and implement a dust control program. To date, only Tessie Brown (Herman Brown's widow) and the H. Brown Company have complied with the UAO, erecting a fence with a windskirt around the site and performing limited air monitoring.

The RI was conducted from November 1988 to March 1991. During the RI, the nature and extent of contamination at the site was determined, contaminant fate and transport was examined, and a baseline risk assessment was conducted. This information is summarized below. The June, 1992, RI report provides further details.

On June 23, 1992, U.S. EPA made an offer of a de minimis settlement to approximately 1400 PRPs. Using site documents obtained from Herman Brown, the Agency calculated that each of these PRPs contributed less than 0.1% of the volume of waste to the site. In the proposed settlement a payment schedule is presented which consists of three tiers. The tiers are based upon volume of hazardous substances contributed by the PRPs. The payments specified for each respective tier are \$1,000, \$5,000, and \$10,000. The settlement was structured such that the Agency would recover approximately 10% of past and future response costs. On July 30, 1992, the Agency held a meeting with the de minimis parties in Grand Rapids, Michigan with approximately 700 of the de minimis parties attending. At that meeting the Agency explained the settlement and answered questions. Copies of the documents linking each of the parties to the site were also distributed. The deadline for the parties to commit to the settlement by providing signature pages to the Agency, was September 22, 1992.

3. Highlights of Community Participation

Community interest with the site had been minimal throughout the RI/FS process. In May 1989, a fact sheet was sent out informing the public about the Superfund process and describing the activities planned for the RI/FS. EPA held an availability session at the Walker Community Building, on May 23, 1989 to discuss the planned RI/FS process. On June 5, 1990, another availability session was held at the Walker Community Building, to discuss the results of the first phase of the RI. Approximately 30 people attended this session.

U.S. EPA released the Final RI/FS reports for the H. Brown site to the public on July 8, 1992, for public comment. These two documents were made available to the public in both the administrative record maintained at the United States Environmental Protection Agency (U.S. EPA) Docket Room in Region V and at the Walker City Hall. The documents were also made available at the public information repositories maintained at Walker City Hall and Kent County Public Library - Walker Branch. The notice of availability for these two documents was published in the Grand Rapids Press on July 2, 1992.

The advertisement also announced that a public comment period on the proposed plan and its underlying documents was to be held from July 8, 1992 to August 6, 1992. On July 24, 1992, U.S. EPA ran another advertisement in the Grand Rapids Press announcing a 30-day extension to the public comment period, extending it until September 8, 1992. In addition, a public meeting was held on July 30, 1992, at the Amway-Grand Plaza Hotel in Grand Rapids, Michigan. At this meeting, representatives from U.S. EPA and the MDNR answered questions about problems at the site and the remedial alternatives under consideration. Approximately 100 people attended that meeting. A response to the comments received during this period is included in the Responsiveness Summary, which is part of this ROD. The provisions of Sections 113(k)(2)(B)(i)-(v) and 117 of the Comprehensive Environmental Response Compensation and Liability Act of 1980 (CERCLA), as amended have been satisfied.

4. Scope and Role of Operable Unit or Response Action Within Site Strategy

This Record of Decision (ROD) addresses the final remedy for the site. The threats posed by this site to human health and the environment are primarily lead contaminated soil, battery casings, sediments, surface water, and groundwater.

The contaminated soil and battery casings are the source materials for contamination at the site and are classified as principal threat waste. Principal threat wastes are considered to be those source materials that are highly toxic or highly mobile that generally cannot be reliably contained or would present significant risk to

human health or the environment should exposure occur. Contaminated ground and surface water will also be treated.

5. Summary of Site Characteristics

Pursuant to the authorities under the CERCLA, as amended, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), an RI and FS were conducted at the site.

Figure 4 thru 7 show the sampling locations for soil, surface water, sediments and groundwater. During the RI/FS the following conditions were observed at the H. Brown site:

1. Visual Appearance

Batteries and scrap metal are stored on the ground or on pallets throughout the currently active area of H. Brown. Within this area, the ground is covered by a mixture of materials, collectively referred to as "fill material." The fill material includes sand, silt, and debris, such as battery chips, lead mesh from battery cores, and other by-products of battery reclamation operations. In general, the concentration of battery chips in the fill material increases to the northeast. A large pile of battery chips, approximately 100 feet by 100 feet by 15 feet high, lies in the fenced portion of the central area of the H. Brown Co. property. Battery chips and debris extend beyond the current, northern boundary of H. Brown. An underground storage tank formerly used for fuel oil was located in the southwestern area of H. Brown. This area has been backfilled with sand after the tank was removed; a polyvinyl chloride (PVC) standpipe has been installed as a vent.

2. Surface Drainage

The site is essentially flat, with no drainage controls. Much of the surface runoff from within the current boundaries of H. Brown collects in a small depression located in the southeastern part of the fenced portion. The surface runoff from the rest of the site flows either to the east, towards an ephemeral wetland area, or to the west, towards Turner Avenue, where it enters the storm sewer system.

Southbound US-131 is elevated above the level of the site, restricting surface drainage further east and resulting in an ephemeral wetland. The surface water ponded in the wetland flows east under southbound US-131 through two culverts, one behind the northeast corner of H. Brown and another behind the eastern boundary of Zenith Auto Parts. These culverts discharge to the floodplain of the Grand River.

Surface water may also enter the City of Walker storm sewer, which runs from north to south along Turner Avenue. To the north, the storm sewer discharges into an unnamed drain that runs east to the

Figure 4

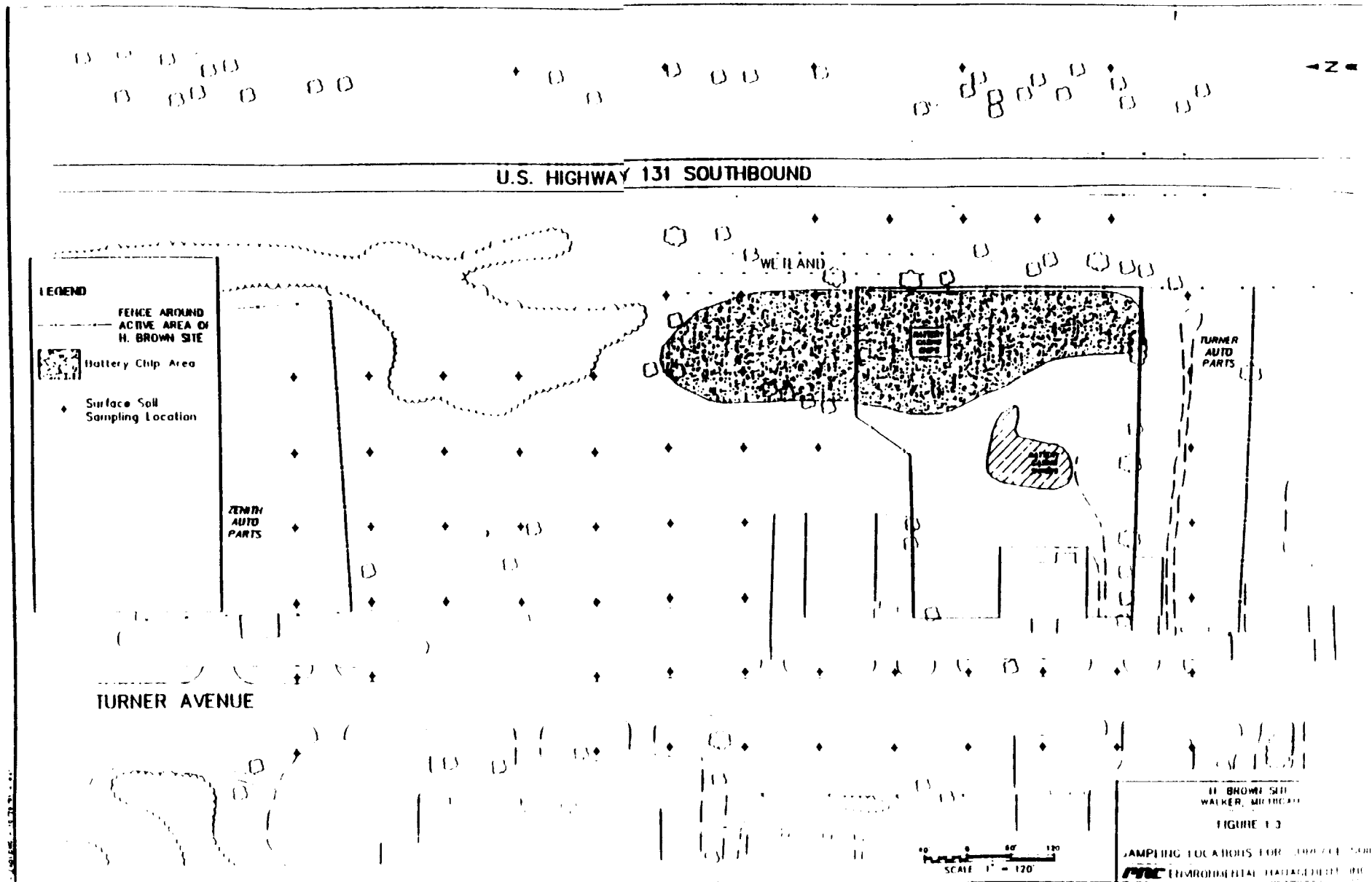
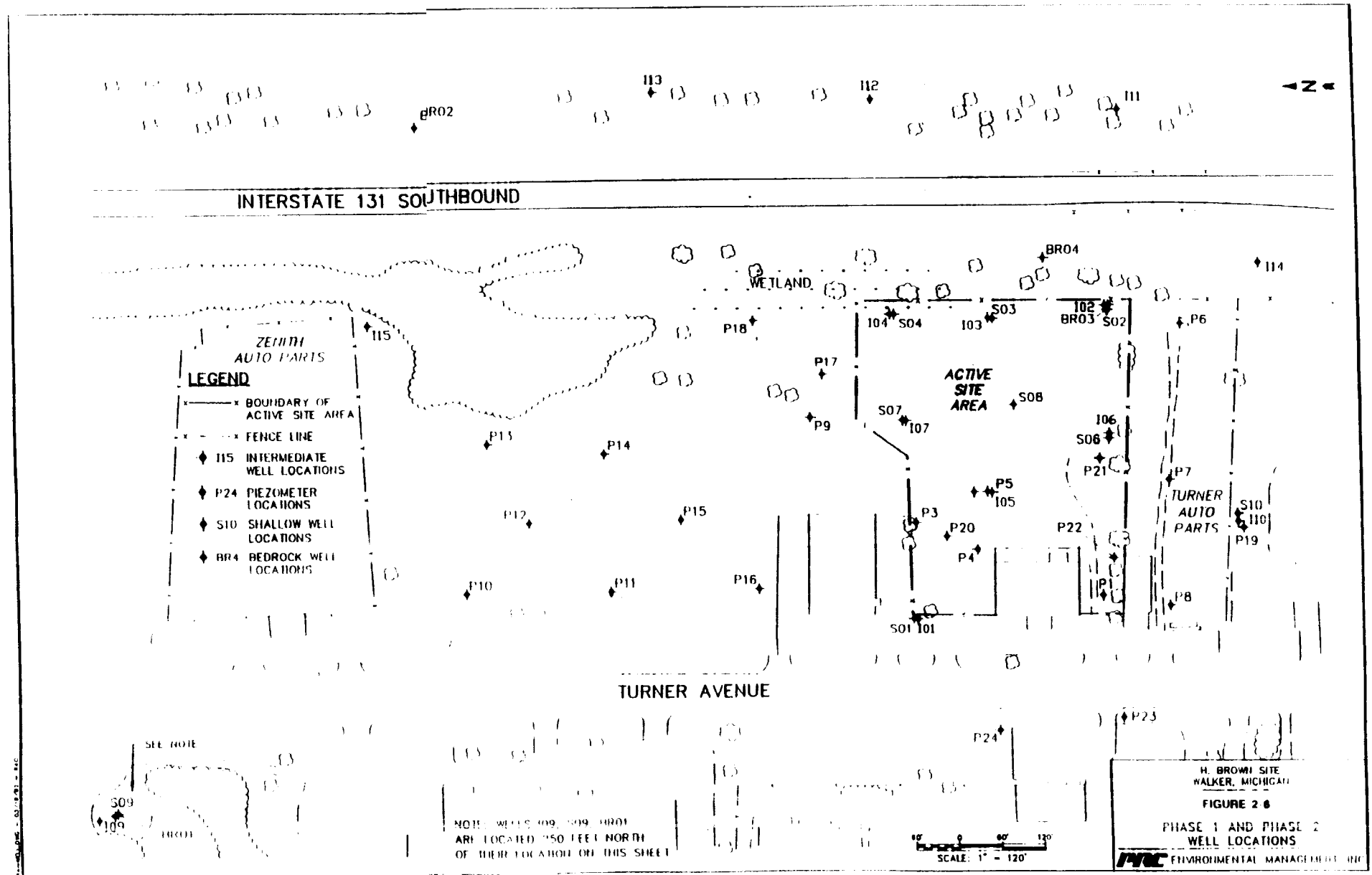
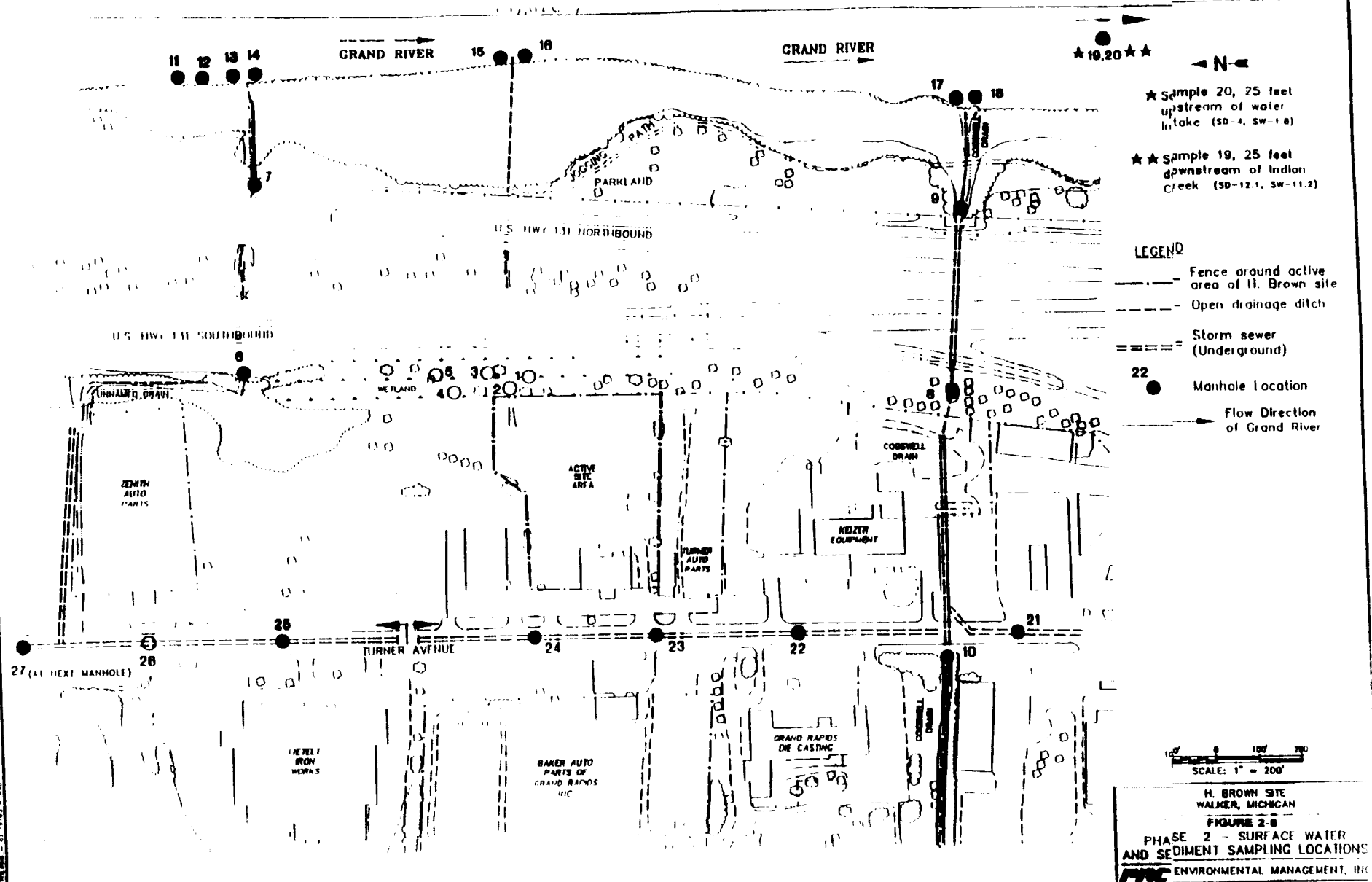


Figure 6





Grand River. To the south, the storm sewer discharges into the Cogswell Drain, which receives runoff from areas to the west and south of Keizer Equipment as well, and then flows east into the Grand River. See Figure 7.

3. Site Geology and Hydrogeology

The H. Brown site lies within the southern portion of the Michigan Basin structure, which consists of sedimentary rocks dipping gently to the north. In the site area, the sedimentary bedrock is covered by a veneer of glacial alluvial drift, consisting of glacial outwash, lake beds, sand, or spillways.

From a hydrogeologic point of view, the subsurface at the site consists of the following four, distinct formations:

- Topmost layer of fill material, approximately 15 feet thick; this layer is referred to as the "shallow aquifer";
- A layer of clay, approximately 4 feet thick on average, just underneath the shallow aquifer; this clay layer is referred to as the "aquitard";
- A layer of glacial outwash material that lies underneath the aquitard, except in the western portion of the site where it is in direct contact with the shallow aquifer; this layer is referred to as the "intermediate aquifer"; and,
- Sedimentary bedrocks, referred to as the "deep aquifer."

The shallow aquifer is recharged by infiltration of surface water resulting primarily from precipitation on the site area. Therefore, the flow of groundwater in the shallow aquifer varies throughout the year. The groundwater in the intermediate and deep aquifers flows uniformly to the southeast.

The RI activities revealed that the intermediate aquifer receives groundwater from the deep aquifer; it also has some potential to receive water from the shallow aquifer.

4. Contamination

The analyses of the air, soil gas, surface soil, subsurface soil, surface water, sediment, and the groundwater at the site revealed that lead is the primary contaminant in all media at the site. Other metals, including arsenic, barium, chromium, and copper, were also detected, but at much lower concentrations. Among organic contaminants, volatile organic compounds (VOC), semivolatile organic

compounds (SVOC), and polychlorinated biphenyls (PCB) were detected in surface soil, subsurface soil, sediments, and groundwater.

Soil gas sample analysis indicated that the soil gas at the site consists primarily of methane and hydrogen sulphide. Both gases may be by-products of natural, biological decomposition of organic waste. Therefore, the investigation of contamination in soil gas was not pursued after preliminary RI activities.

The nature and extent of contamination in air, soil, groundwater, and surface water and sediments at the site are summarized below.

Air

Air at the site is contaminated by dust from the site; it has particulate matter containing lead and other contaminants present in surface soil at the site. In August 1989, eight air samples from various upwind and downwind locations at the site were collected. Using these samples, the highest concentration of lead in air at the site was found to be 23.7 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$), in an area affected by facility operations, such as loading and unloading trucks and operating a forklift. The lowest measured concentration of lead in air was 0.82 $\mu\text{g}/\text{m}^3$, at a location upwind of the site.

Soil

Samples from surface and subsurface soil at the site were collected and analyzed for total analyte list (TAL) metals and target compound list (TCL) organics in May and June 1989, and again in August 1990.

Figures 4 and 5 show the sampling locations for surface and subsurface soil, respectively. Tables 1 through 4 present analytical results of soil sampling conducted at the site. These tables also present the statistical information related to the detection of TAL metals and TCL organics in soil samples.

Data indicate that surface soils are contaminated with a variety of SVOCs and PCBs. In addition, VOCs and pesticide compounds were detected at low levels and low frequencies. When the on-site concentrations of VOCs, SVOCs, and pesticide compounds are compared to background concentrations, it is evident that many contaminants with elevated concentrations in site soils are also present in background soils. Also, individual SVOC, VOC, and pesticide compounds may be comparatively elevated in either background or site soil samples.

Some metals, such as aluminum, copper, iron, and zinc, naturally occur at high concentrations in soil; detection of such metals in soil does not necessarily indicate soil contamination at the site. Other metals, such as antimony, arsenic, and lead, do not naturally occur at high concentrations in the soil. Therefore, detection of

TABLE 1

INORGANIC CONTAMINANTS DETECTED IN SURFACE SOIL

Contaminant	Detection Frequency ^a	Range of Detected Concentrations (mg/kg)	Mean	95% UCL ^b
Aluminum	60 of 60	213 to 23,200	4,501	5,317
Antimony	60 of 60	4.3 to 4,980	896	1,191
Arsenic	60 of 60	5.2 to 463	91.5	115
Barium	60 of 60	24 to 1,090	200	245
Beryllium	33 of 60	0.3 to 13.6	0.7	1.1
Cadmium	46 of 60	0.6 to 32.4	2.9	4.1
Calcium	60 of 60	2,400 to 97,100	15,944	19,402
Chromium	57 of 60	7.5 to 214	39.6	49.9
Cobalt	56 of 60	1.2 to 14.2	4.1	4.8
Copper	60 of 60	27.4 to 4,400	557	767
Cyanide	10 of 43	1.0 to 3.9	0.8	1.0
Iron	60 of 60	1,280 to 153,000	24,293	30,088
Lead	60 of 60	806 to 265,000	110,123	130,150
Magnesium	59 of 60	252 to 18,500	5,129	6,010
Manganese	59 of 60	28.2 to 647	223	252
Mercury	52 of 60	0.1 to 1.8	0.4	0.5
Nickel	56 of 60	6.9 to 197	37.9	46.9
Potassium	57 of 60	208 to 1,100	464	523
Selenium	9 of 24	0.2 to 4.0	0.4	0.8
Silver	15 of 60	1.0 to 9.2	1.4	1.9
Sodium	54 of 60	63.6 to 345	115	129
Vanadium	56 of 60	5.0 to 49.4	12.2	13.9
Zinc	60 of 60	41.9 to 2,040	361	438

Notes: ^a A detection frequency of "33 of 60" indicates that contaminant was detected in 33 of 60 samples
^b 95 percent upper confidence limit of arithmetic mean of detected concentrations

TABLE 2

ORGANIC CONTAMINANTS DETECTED IN SURFACE SOIL

Contaminant	Detection Frequency ^a	Range of Detected Concentrations (µg/kg)	Mean	95% UCL ^b	Contaminant	Detection Frequency	Range of Detected Concentrations (µg/kg)	Mean	95% UCL
VOCs					Pyrene	15 of 17	210 to 120,000	10,264	24,941
Methylene Chloride	1 of 17	46			Butylbenzylphthalate	6 of 17	120 to 670	175	278
Acetone	1 of 17	83			Benzo(a)anthracene	12 of 17	100 to 8,000	1,365	2,458
Carbon Disulfide	5 of 17	2.0 to 6.0	1.9	2.8	Chrysene	15 of 17	200 to 120,000	9,273	23,992
1,2-dichloroethene	4 of 17	2.0 to 5.0	1.6	2.2	Bis(2-ethylhexyl)phthalate	13 of 17	510 to 120,000	17,116	33,190
1,1,1-trichloroethane	3 of 17	6.8 to 63	9.3	16.8	Di-n-octylphthalate	2 of 17	330 to 4,700		
Trichloroethene	5 of 17	3.0 to 8.0	2.8	3.9	Benzo(b)fluoranthene	14 of 17	180 to 8,700	1,914	3,049
Tetrachloroethane	5 of 17	7.0 to 26	8.0	12.2	Benzo(k)fluoranthene	11 of 17	83 to 4,000	1,041	1,716
Styrene	2 of 17	0.8 to 1.0			Benzo(a)pyrene	12 of 17	360 to 6,000	1,495	2,336
Toluene	17 of 17	2.0 to 32	8.4	15.4	Indeno(1,2,3-cd)pyrene	5 of 17	690 to 4,200	952	1,579
Xylenes	1 of 17	2.0			Dibenz(a,h)anthracene	2 of 17	790 to 1,600		
SVOCs					Benzo(g,h,i)pyrene	6 of 17	1,100 to 8,300	1,594	2,640
Phenol	5 of 17	100 to 400	109	168	Pesticides and PCBs				
2-Methylphenol	3 of 17	160 to 1,160	184	335	Delta BHC	4 of 17	8.2 to 35	7.9	12.3
Isopropene	2 of 17	205 to 240			Dieldrin	5 of 17	18 to 290	41.9	79.7
Benzoic Acid	2 of 17	280 to 780			4,4-DDE	8 of 17	20 to 110	30.1	47
Naphthalene	8 of 17	190 to 9,700	909	2,092	Endrin	2 of 17	33 to 110		
2-Methylnaphthalene	10 of 17	170 to 7,300	752	1,634	4,4-DDD	7 of 17	23 to 84	24	34.2
Acenaphthylene	1 of 17	95			4,4-DDT	9 of 17	38 to 180	71.9	104
Acenaphthene	7 of 17	99 to 5,800	524	1,238	Endrin ketone	10 of 17	17 to 78	28.2	40.4
Dibenzofuran	7 of 17	130 to 4,500	445	995	Alpha-chlordane	2 of 17	250 to 295		
Fluorene	9 of 17	79 to 4,200	442	964	Gamma-chlordane	3 of 17	92 to 250	64.4	90.8
N nitrosodiphenylamine	6 of 17	82.5 to 2,500	251	555	Aroclor-1221	2 of 17	4,300 to 12,000		
Phenanthrene	15 of 17	230 to 120,000	9,761	24,502	Aroclor-1231	1 of 17	2,000		
Anthracene	10 of 17	110 to 3,600	562	1,077	Aroclor-1242	3 of 17	670 to 1,100	422	531
Di-n-Butylphthalate	4 of 17	120 to 710	113	194	Aroclor-1254	11 of 17	810 to 8,200	1,573	2,595
Fluoranthene	13 of 17	210 to 120,000	9,092	23,858					

Notes: ^a A detection frequency of "1 of 17" indicates that contaminant was detected in one of 17 samples

^b 95 percent upper confidence limit of arithmetic mean of detected concentrations

A blank cell in the table implies that corresponding statistical parameter could not be calculated because of infrequent detection of contaminant

TABLE 3

INORGANIC CONTAMINANTS DETECTED IN SUBSURFACE SOIL

Contaminant ^a	Detection Frequency ^b	Range of Detected Concentrations (mg/kg)	Mean	95% UCL ^c	Contaminant	Detection Frequency	Range of Detected Concentrations (mg/kg)	Mean	95% UCL
Aluminum	38 of 38 18 of 18	2,310 to 19,300 195 to 18,300	7,669 5,914	9,083 8,252	Magnesium	38 of 38 18 of 18	2,050 to 33,900 19.7 to 12,800	8,034 4,844	9,808 6,803
Antimony	19 of 38 14 of 18	3.8 to 1,030 2.8 to 6,560	57.6 637	117 1,407	Manganese	38 of 38 18 of 18	98.6 to 2,350 15 to 512	420 218	542 291
Arsenic	38 of 38 18 of 18	2.1 to 104 2.4 to 254	16.5 43	23.8 73.7	Mercury	27 of 38 13 of 18	0.12 to 1.5 0.1 to 0.6	0.4 0.2	0.5 0.3
Barium	38 of 38 18 of 18	41.8 to 1,000 13.3 to 532	254 140	322 200	Nickel	38 of 38 18 of 18	10.6 to 1,300 1.6 to 123	106 24.8	178 39.4
Beryllium	34 of 38 12 of 18	0.2 to 2.0 0.3 to 1.5	0.5 0.5	0.7 0.7	Potassium	38 of 38 17 of 18	211 to 2,080 135 to 1,720	649 621	774 847
Cadmium	13 of 38 5 of 18	0.6 to 32.8 0.5 to 4.7	1.9 0.7	3.6 1.3	Selenium	8 of 38 4 of 18	0.72 to 2.6 0.4 to 1.6	0.5 0.4	0.7 0.5
Calcium	38 of 38 18 of 18	3,970 to 110,000 528 to 50,800	30,276 22,174	37,637 30,246	Silver	6 of 38 6 of 18	1.1 to 13.8 0.6 to 6.0	1.0 1.2	1.7 2.0
Chromium	38 of 38 18 of 18	8.6 to 165 2.8 to 254	42.3 39	53.4 68.7	Sodium	38 of 38 18 of 18	47.3 to 2,270 54.1 to 283	269 135	387 162
Cobalt	38 of 38 18 of 18	3.0 to 82.3 1.1 to 26.1	9.1 6.2	13.2 9.1	Thallium	3 of 38 2 of 18	0.5 to 2.7 1.0 to 2.3	0.3 0.6	0.5 0.8
Copper	37 of 38 18 of 18	3.7 to 1,390 19.4 to 1,000	178 199	255 339	Vanadium	36 of 38 13 of 18	5.0 to 55.5 2.9 to 23.2	17.4 8.8	20.9 12.3
Iron	38 of 38 18 of 18	5,500 to 162,000 902 to 97,700	38,847 25,147	49,425 38,541	Zinc	38 of 38	27.9 to 6,280	793	1,159
Lead	38 of 38 18 of 18	7.2 to 622,000 118 to 649,000	26,236 64,125	58,670 142,400		18 of 18	30.8 to 1,780	345	595

Notes: ^a Information related to contaminants detected within currently active area appear as normal text; those detected outside currently active area appear as shaded text

^b A detection frequency of "36 of 38" implies that the contaminant was detected in 36 of 38 samples

^c The 95% upper confidence limit (UCL) on the arithmetic mean concentration of detected contaminant in soil

TABLE 4

ORGANIC CONTAMINANTS DETECTED IN SUBSURFACE SOIL

Contaminant	Detection Frequency ^a	Range of Detected Concentrations (µg/kg)	Mean	95% UCL ^b	Contaminant	Detection Frequency	Range of Detected Concentrations (µg/kg)	Mean	95% UCL
VOCs					4-Chlorophenyl-phenylether	1 of 14	4,000		
Vinyl Chloride	1 of 18	14			Fluorene	9 of 16	230 to 6,700	1,565	2,593
Methylene Chloride	12 of 18	2.3 to 18	4.4	6.5	N-Nitrosodiphenylamine	3 of 16	860 to 4,600		
Acetone	16 of 18	6.0 to 1,100	202	384	Phenanthrene	15 of 17	530 to 30,500	7,042	11,417
Carbon Disulphite	11 of 18	1.5 to 970	79.9	194	Anthracene	10 of 16	330 to 6,700	1,753	2,902
2-butanone	5 of 18	16 to 170	35.8	63.3	Di-n-Butylphthalate	3 of 15	380 to 8,600		
1,1,1-trichloroethane	2 of 18	5.0 to 8.0			Fluoranthene	17 of 17	410 to 33,500	6,803	11,322
Trichloroethene	1 of 18	7.0			Pyrene	17 of 18	460 to 36,000	7,055	11,470
Benzene	1 of 18	8.0			Butylbenzylphthalate	1 of 14	98,000		
Toluene	13 of 18	4.0 to 18	18.1	27.6	Benzo(a)anthracene	10 of 15	430 to 15,950	3,166	5,601
Chlorobenzene	1 of 18	27			Chrysene	14 of 18	680 to 15,400	4,165	6,332
Ethylbenzene	6 of 18	7.0 to 2,000	125	358	Bis(2-ethylhexyl)phthalate	10 of 16	540 to 110,000	15,948	31,576
Total Xylenes	6 of 18	9.0 to 9,300	533	1,621	Di-n-octylphthalate	1 of 14	1,600		
SVOCs					Benzo(b)fluoranthene	11 of 16	980 to 15,700	3,058	11,576
2-Methylphenol	1 of 15	5,800			Benzo(k)fluoranthene	7 of 14	660 to 10,900	2,239	4,108
4-Methylphenol	1 of 15	4,100			Indeno(1,2,3-cd)Pyrene	5 of 14	380 to 4,300	771	1,435
2,4-Dimethylphenol	1 of 15	3,500			Dibenz(a,h)anthracene	1 of 14	3,900		
Napthalene	12 of 17	230 to 5,300	1,581	2,343	Benzo(g,h,i)perylene	5 of 14	380 to 2,875	687	1,190
2-Methylnapthalene	13 of 18	150 to 3,800	1,095	1,684	Pesticides and PCBs				
Acenaphthylene	2 of 14	293 to 460			4,4'-DDD	4 of 18	110 to 750	131	232
Acenaphthene	7 of 15	160 to 3,700	937	1,608	4,4'-DDT	1 of 18	325		
Dibenzofuran	8 of 15	160 to 5,500	1,104	1,928	Aroclor-1221	3 of 18	2,025 to 56,000		
2,4-Dinitrotoluene	1 of 14	4,000			Aroclor-1242	2 of 18	6,600 to 11,000		
Dimethylphthalate	1 of 14	4,000			Aroclor-1254	4 of 18	2,900 to 9,600	2,511	3,798

Notes: ^a A detection frequency of "1 of 18" indicates that contaminant was detected in one of 18 samples

^b 95 percent upper confidence limit of arithmetic mean of detected concentrations.

A blank cell in the table implies that corresponding statistical parameter could not be calculated because of the infrequent detection of the contaminant

such metals in high concentrations in soil at the site indicates soil contamination.

As indicated in Tables 1 and 3, lead and antimony were detected in soil at much higher levels than other inorganic contaminants. In addition, concentrations of antimony detected in soil at the site were in proportion to those of lead in soil. Both observations indicated that (1) the soil at the site is contaminated primarily by lead and antimony and (2) the contamination of soil at the site is related to past battery reclamation activities at the site.

The contamination of soil by lead is selected to represent the extent of surface and subsurface soil contamination at the site. The RI report should be referred to for more details of the extent of soil contamination by substances other than lead.

Estimated Soil Volumes

The total volume of battery chips was estimated to be 33,000 cubic yards (cy), out of which approximately 15,000 cy is stockpiled on the surface and the remaining 18,000 cy is mixed with the fill. The volume of soil to be remediated, including battery chips, is estimated at 180,000 cy. Approximately 50,000 cy of soil is estimated to have lead concentrations more than 20,000 mg/kg; the remaining 130,000 cy of soil is estimated to have lead concentrations between 20,000 and 500 mg/kg.

All settled sediments above cleanup levels, in storm sewers and drainage ditches, should also be remediated.

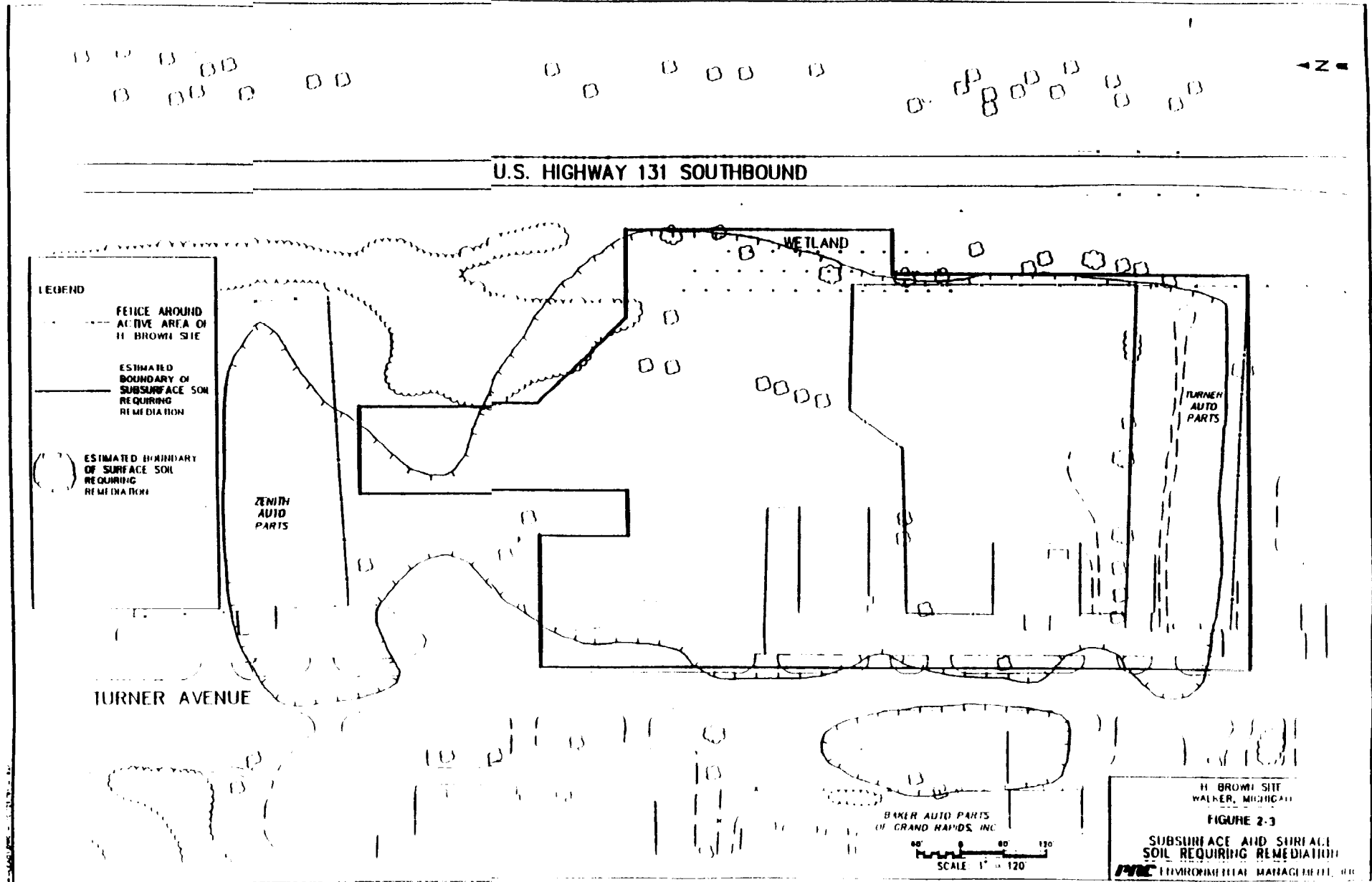
Surface Soil

Highest and lowest concentrations of lead in surface soil within the currently active area of H. Brown were found to be 265,000 and 800 mg/kg, respectively. Corresponding concentrations outside the currently active area of H. Brown were found to be 380,000 and 58 mg/kg, respectively.

Figure 8 shows isoconcentration contours for lead in surface soil within the currently active area of H. Brown. The highest concentrations of lead in surface soil were detected in the following areas:

- An area surrounding the location of former battery shredder in the center of the fenced portion;
- An area west of the former shredding operation and within the fenced area, where battery chips are accumulated; and,
- An area just north of the eastern portion of the fenced area, where battery chips were disposed.

Figure 8



Subsurface Soil

Subsurface soil samples were first obtained from waste characterization and well borings within the currently active area of H. Brown. Samples were later collected from other locations for an improved assessment of the nature and extent of contamination in areas of known or suspected lead-contaminated surface soil. Figure 9 shows the concentrations of lead in subsurface soil at various depths at sampling locations within the currently active area of H. Brown.

Concentrations of lead decrease dramatically with depth. For example, concentrations of lead decrease by two orders of magnitude within the first 5 feet from the ground surface. At 12 feet below the ground surface, high concentrations of lead are limited to isolated spots. Below the aquitard, lead concentrations are comparable to the background levels of lead in subsurface soil.

Groundwater

The groundwater in all three aquifers (shallow, intermediate, and deep) is contaminated; contaminants detected in these aquifers are presented in Tables 5 and 6. Contaminants and the statistical information related to their detection in shallow, intermediate, and deep aquifers are presented in these tables as normal, shaded, and bold text, respectively.

Many inorganic elements, such as calcium, iron, and manganese, naturally occur at high concentrations in the groundwater. Detection of these inorganics at high concentrations in groundwater at the H. Brown site does not mean that the groundwater at the site is contaminated by them. However, the occurrence of inorganic metals such as antimony, arsenic, and lead at high concentrations and of all organic compounds is not natural. Therefore, their detection in groundwater at the H. Brown site is an indication of ground-water contamination.

Considering above mentioned differences in concentrations that generally define the contamination by an inorganic element or an organic compound, Tables 5 and 6 indicate that the shallow aquifer at the site is contaminated primarily by inorganic contaminants. The intermediate and deep aquifers are contaminated primarily by organic contaminants. Some organic contaminants detected in the intermediate and deep aquifers, such as vinyl chloride, were not detected in the soil or the shallow aquifer at the H. Brown site. Therefore, the contamination of intermediate and deep aquifer may not be solely associated with the battery reclamation activities at the site, which primarily involves inorganic chemicals. Contamination of groundwater in the shallow aquifer is directly related to Herman Brown's activities. Ubiquitous, high concentrations of lead in groundwater can be associated with

Figure 9

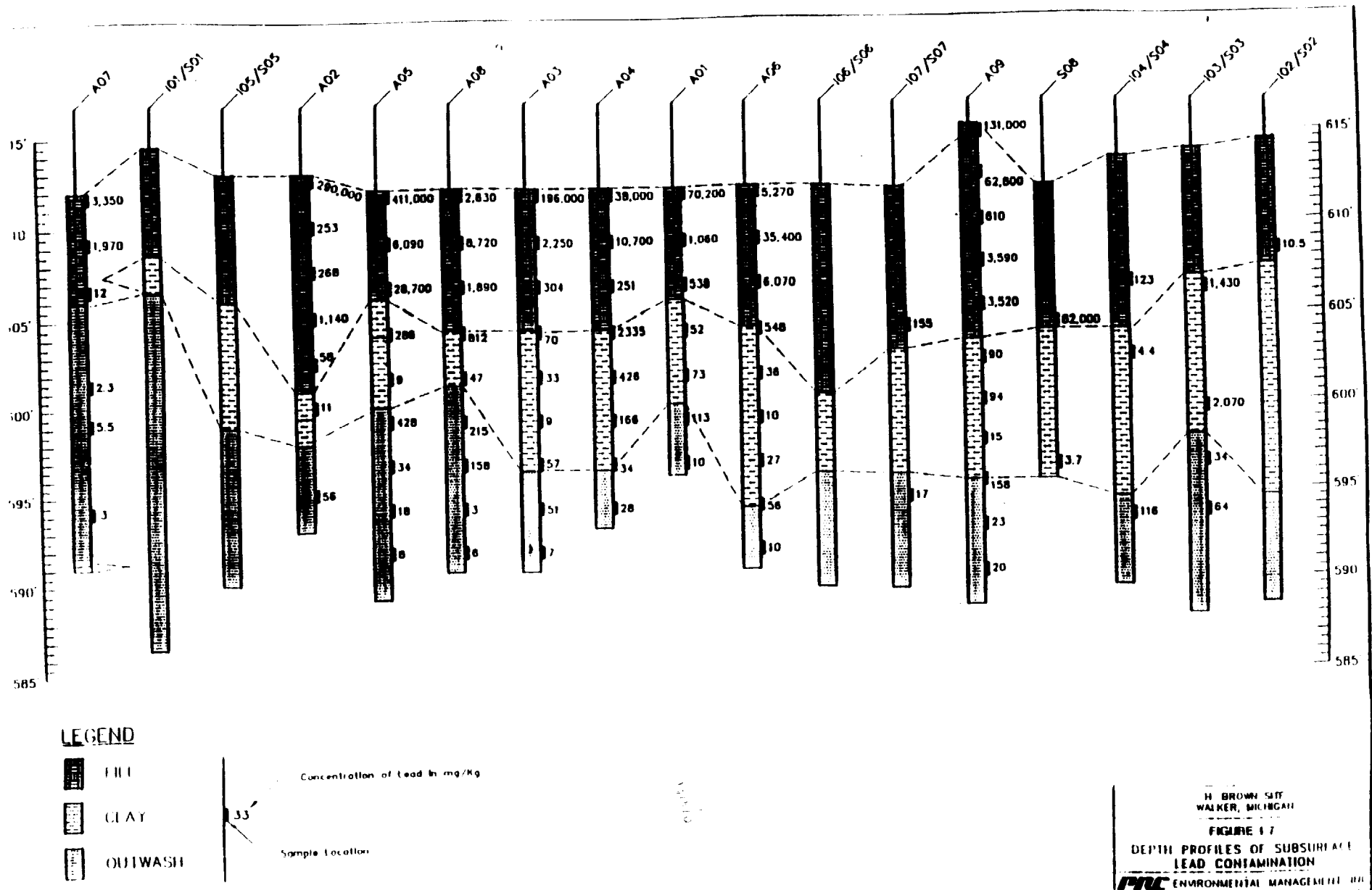


TABLE 5

INORGANIC CONTAMINANTS DETECTED IN GROUND WATER

Contaminant ^a	Detection Frequency ^b	Range of Detected Concentrations (µg/L)	Mean	95% UCL ^c	Contaminant	Detection Frequency	Range of Detected Concentrations (µg/L)	Mean	95% UCL
Aluminum	26 of 26 13 of 14 7 of 7	43.3 to 111.900 183 to 40.400 28.6 to 639	19,282 5,245 192	30,772 11,214 400	Magnesium	26 of 26 14 of 14 7 of 7	12,150 to 352,000 44,500 to 307,000 31,200 to 246,000	91,712 124,832 107,214	125,707 168,691 195,508
Ammonia	6 of 26	26.3 to 281	37.2	62.7	Manganese	26 of 26 14 of 14 7 of 7	247 to 9,080 337 to 3,060 21.0 to 466	1,710 880 161	2,485 1,257 320
Arsenic	26 of 26 11 of 14 3 of 7	1.8 to 370 1.2 to 224 2.9 to 3.7	34.5 18.6 2.27	64.1 52.7 3.24	Mercury	12 of 26 1 of 14 1 of 7	0.25 to 4.7 0.15 0.81	0.5	0.9
Barium	26 of 26 14 of 14 7 of 7	115 to 1450 54.3 to 663 20.2 to 88.2	588 296 44.4	734 423 67.8	Nickel	23 of 26 8 of 14	10.7 to 3,190 7.8 to 157	198 23.6	447 49.12
Beryllium	6 of 26 1 of 14	0.83 to 4.95 1.9	1.0	1.47	Potassium	26 of 26 14 of 14 7 of 7	1,220 to 68,300 2,840 to 18,000 7.3 to 10,800	17,597 7,759 4,693	23,467 10,701 8,484
Cadmium	10 of 26 1 of 14	1.4 to 21.7 8.0	4.33	6.66	Selenium	1 of 23	1.2		
Calcium	26 of 26 14 of 14 7 of 7	112,500 to 1,060,000 161,000 to 582,000 183,000 to 449,000	345,885 323,286 276,071	435,455 393,707 379,498	Silver	4 of 26	1.0 to 5.2	1.0	1.5
Chromium	22 of 26 8 of 14	6.32 to 219 6.6 to 88.6	61.4 14.1	86.5 26.9	Sodium	26 of 26 14 of 14 7 of 7	7,630 to 989,000 13,050 to 506,000 20,050 to 241,000	74,967 188,918 98,843	152,754 284,755 190,685
Cobalt	22 of 26 9 of 14	6.4 to 65.9 4.4 to 70.8	18.0 16.1	24.8 28.3	Thallium	1 of 18	6.2		
Copper	24 of 26 9 of 14 3 of 7	5.0 to 1,660 2.47 to 130 4.8 to 8.2	254 20.7 4.02	416 41.6 6.12	Vanadium	23 of 26 11 of 14 1 of 7	5.2 to 297 3.4 to 108 7.3	47.3 16.0	79.7 31.7
Iron	26 of 26 14 of 14 7 of 7	692 to 373,000 2,230 to 132,000 859 to 26,800	63,491 26,431 7,993	94,894 45,449 16,866	Zinc	26 of 26 13 of 14 7 of 7	8.6 to 40,500 21.1 to 463 76.9 to 4,260	4,474 92.8 920	7,824 161.0 2,314
Lead	26 of 26 13 of 14 6 of 6	3.8 to 18,800 2.5 to 223 1.42 to 9.7	1,876 42.9 4.85	3,475 77.4 8.6					

Notes: Contaminants detected in the shallow aquifer and information related to them appear as normal text in the table. Contaminants detected in intermediate and deep aquifers and information related to them appear as shaded and bold text, respectively.

A detection frequency of "1 of 26" implies that the contaminant was detected in 1 of the 26 samples collected; a detection frequency of "3 of 26" implies that the contaminant was detected in 3 of 26 samples collected; and so on.

95 percent upper confidence limit of the arithmetic mean concentration of a contaminant.

A blank in the table indicates that the contaminant was either not detected or the detection frequency was insufficient for calculation of the parameter represented by the blank.

TABLE 6

ORGANIC CONTAMINANTS DETECTED IN GROUND WATER

Contaminant ^a	Detection Frequency ^b	Range of Detected Concentrations (µg/L)	Mean	95% UCL ^c	Contaminant	Detection Frequency	Range of Detected Concentrations (µg/L)	Mean	95% UCL
VOCs					Napthalene	1 of 9	5		
Vinyl chloride	2 of 9 8 of 14	4.0 to 9.0 7.0 to 59	12.0	20.5	N-Nitrosodiphenylamine	1 of 9	6		
1,1-Dichloroethene	3 of 7	6.0 to 9.0	5.0	7.4	Phenanthrene	1 of 9	7		
1,1-Dichloroethene Chloride	2 of 7	2.0 to 3.0			Anthracene	1 of 9	2		
Carbon Disulfide	2 of 9	7 to 16			Di-n-Butylphthalate	1 of 9 1 of 14	1 1		
1,2-Dichloroethene (total)	2 of 9 2 of 14 2 of 7	4 to 45 5 to 25 25 to 38			Fluoranthene	1 of 9	14		
Carbon Tetrachloride	1 of 14	2			Pyrene	1 of 9	15		
Benzene	2 of 9 1 of 14	4 to 23 3			Butylbenzylphthalate	1 of 7	6		
Tetrachloroethene	1 of 14	1			Benzofluoranthene	1 of 9	15		
Toluene	3 of 9	4.25 to 93	13	36	Chrysene	1 of 9	14		
Chlorobenzene	3 of 9	3 to 9	3.3	5.8	Bis(2-ethylhexyl)phthalate	1 of 9 1 of 7	31 61		
Ethylbenzene	2 of 9	18 to 140			Benzofluoranthene	1 of 9	24		
Total Xylenes	2 of 9	29 to 340			Benzofluoranthene	1 of 9	16		
SVOCs					Benzofluoranthene	1 of 9	19		
Phenol	1 of 9 1 of 14	15 8			Indeno(1,2,3-cd)pyrene	1 of 9	19		
4-Methylphenol	1 of 9	32			Dibenz(a,h)anthracene	1 of 9	6		
Benzoic Acid	1 of 9	15			Benzofluoranthene	1 of 9	21		
					Pesticides				
					Heptachlor	1 of 9	0.08		
					Dieldrin	1 of 9	0.7		

Notes: ^a Contaminants detected in the shallow aquifer and information related to them appear as normal text in the table. Contaminants detected in intermediate and deep aquifers and information related to them appear as shaded and bold text, respectively.

^b A detection frequency of "2 of 9" implies that the contaminant was detected in 2 of 9 samples collected; a detection frequency of "1 of 14" implies that the contaminant was detected in 1 of 14 samples collected, and so on.

^c 95 percent upper confidence limit of arithmetic mean of detected concentrations

battery reclamation activities of Mr. Brown. Sporadic detection of low concentrations of organic contaminants may be associated with former landfilling, an underground storage tank, or site operations. The sources of organic contamination in the intermediate and deep aquifers are not known. The contamination may be associated with former landfilling in the general area of the site, with other industries adjoining the site, or some other unknown activity. Lead is the primary contaminant in the groundwater in the shallow aquifer (see Table 1-5). The detected concentrations of lead there ranged from 3.8 micrograms per liter ($\mu\text{g/L}$) to 18,800 $\mu\text{g/L}$, with 95 or more percent of concentrations [95 percent upper confidence level on arithmetic mean of concentrations (95% UCL)] estimated to be less than or equal to 3,475 $\mu\text{g/L}$. Vinyl chloride is the primary contaminant in the intermediate and deep aquifers (see Table 6) with detected concentrations ranging from 7 to 59 $\mu\text{g/L}$ in the intermediate aquifer and from 6 to 9 $\mu\text{g/L}$ in the deep aquifer. Corresponding 95% UCLs are 12 and 5 $\mu\text{g/L}$ for the intermediate and deep aquifers, respectively.

The extent of contamination in all three aquifers at the H. Brown site is difficult to determine. High background concentrations of lead and some other inorganic contaminants in groundwater in the shallow aquifer make it difficult to determine the extent of contamination in it. The lack of sufficient information about background concentrations of organic contaminants prohibits the determination of the extent of contamination in the intermediate and deep aquifers. Therefore, it was assumed that the contaminated groundwater lies only within portions of the aquifers that lie underneath the contaminated surface soil at the H. Brown Co. property.

Surface Water and Sediments

The surface water and sediments in storm sewers in front of the H. Brown property (on Turner Avenue and south of Keizer Equipment), the drainage ditches, and the wetland area east of the H. Brown property are also contaminated, primarily by lead. The impact of H. Brown on the contamination of surface water and sediments in the storm sewer on Turner Avenue is clearly demonstrated by the increased 95% UCLs for lead concentrations there. The 95% UCLs for lead in water and sediments in this sewer increased from 49.8 $\mu\text{g/L}$ and 111 $\mu\text{g/kg}$, respectively, at background locations to 391 $\mu\text{g/L}$ and 1520 $\mu\text{g/kg}$, respectively, at a location immediately downgradient of the H. Brown site. However, the contamination of surface water and sediments in the storm sewer south of the Keizer Equipment is not solely associated with H. Brown, because this sewer receives lead-contaminated surface water and sediments from areas in addition to H. Brown. The 95% UCL for lead in surface water and sediments contributed to this sewer from the H. Brown property were 391 $\mu\text{g/L}$ and 1520 $\mu\text{g/kg}$, respectively, as compared to 2,700 $\mu\text{g/L}$ and 181 $\mu\text{g/kg}$, respectively, from areas west of the H. Brown property and

10.4 µg/L and 462 µg/kg, respectively, from areas south of the H. Brown property.

Concentrations of lead in surface water and sediments in the wetland area and the drainage ditches running through it were much lower than those detected in surface water and sediments in storm sewers, soil, and groundwater at the H. Brown site. H. Brown-related contaminants other than lead were either detected at very low concentrations or not detected. The RI report (PRC, 1991) should be referred to for further details.

6. Summary of Site Risks

-Human Health Risks

Pursuant to the NCP a baseline risk assessment was performed using analytical data generated during the RI. The baseline RA assumes no corrective action will take place and that no site-use restrictions or institutional controls such as fencing, groundwater use restrictions or construction restrictions will be imposed. However, for the future site scenarios, present action at the site and current plans for development are considered. Potential exposure pathways considered for this site under current and unrestricted future site development scenarios were:

- 1) Inhalation of soil as dust;
- 2) Direct contact with soil;
- 3) Ingestion of soil;
- 4) Direct contact with surface water;
- 5) Direct contact with sediments;
- 6) Incidental ingestion of surface water; and,
- 7) Ingestion of groundwater.

A smaller group of contaminants than all those actually detected at the site was selected to focus the baseline risk assessment. Approximately 50 contaminants were detected in air, soil, groundwater, surface water, and sediments at the H. Brown site. As part of the RA, these contaminants of concern (COCs) were selected to focus the RA on contaminants associated with greatest potential risk. The COCs were selected based on (1) potential human exposure, (2) data evaluation and validation, (3) comparison of naturally-occurring compounds to background concentrations, (4) evaluation of quantification limits, and (5) availability of toxicity data. The COCs selected for various media at the H. Brown site are presented in Table 7.

CONTAMINANTS OF CONCERN IN SOIL, AIR, GROUND WATER, SURFACE WATER, AND SEDIMENTS

	<u>Soil</u>	<u>Air</u>	<u>Ground Water</u>	<u>Surface Water and Sediments</u>
Inorganic	Aluminum Antimony Arsenic Barium Beryllium Cadmium Chromium Copper Lead Manganese Mercury Nickel Silver Vanadium Zinc	Aluminum Antimony Arsenic Barium Beryllium Cadmium Chromium Copper Lead Manganese Mercury Nickel Silver Vanadium Zinc Cyanide	Aluminum Antimony Arsenic Barium Beryllium Cadmium Chromium Cobalt Copper Iron Lead Manganese Mercury Nickel Silver Vanadium Zinc	Aluminum Arsenic Barium Cadmium Chromium Cobalt Copper Iron Lead Manganese Nickel Silver Vanadium Zinc
Volatile Organics	Carbon disulfide Ethylbenzene Toluene Total xylenes	Methylene chloride Toluene Total xylenes	Benzene Carbon disulfide Ethylbenzene Toluene Total xylenes Vinyl chloride	
Polycyclic Aromatic Hydrocarbons (PAHs)	Acenaphthene Anthracene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(g,h,i)perylene Benzo(a)pyrene Bis(2-ethylhexyl) phthalate Chrysene Dibenz(a,h)anthracene Dibenzofuran Di-n-butylphthalate Di-n-octyl Phthalate Fluoranthene Fluorene Indeno(1,2,3-cd)pyrene 2-methylnaphthalene 2-Methylphenol Naphthalene Phenanthrene Pyrene	Acenaphthene Acenaphthylene Anthracene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(g,h,i)perylene Benzo(a)pyrene Chrysene Dibenz(a,h)anthracene Dibenzofuran Fluoranthene Fluorene Indeno(1,2,3-cd)pyrene 2-Methylnaphthalene Naphthalene Phenanthrene Pyrene	Anthracene Benzo(a)anthracene Benzo(b)fluoranthene Benzo(k)fluoranthene Benzo(g,h,i)perylene Benzo(a)pyrene Chrysene Dibenz(a,h)anthracene Di-n-butylphthalate Fluoranthene Indeno(1,2,3-cd)pyrene 2-Methylphenol Naphthalene Phenanthrene Pyrene	
Chlorinated Pesticides & Herbicides	DDD DDT		Dieldrin Heptachlor	
Misc. Organics	N-Nitrosodiphenylamine Phenol PCB	Dibenzofuran Di-n-butylphthalate Di-n-octyl Phthalate 2-Methylphenol N-Nitrosodiphenylamine Phenol PCB	Bis(2-ethylhexyl) phthalate N-Nitrosodiphenylamine Phenol	

* Air is contaminated by dust from the site

Lead is the single most important COC in all media at the site because of its ubiquitous presence in high concentrations and the adverse health effects associated with exposure to even low concentrations of lead.

For each exposure pathway evaluated, carcinogenic and noncarcinogenic health risks were characterized for the reasonable maximum exposure risk scenario, for current site conditions, and for future site development. EPA assumed potential future residential use of site property based on Agency guidance and the proximity of nearby residences. Table 8 lists the exposure assumptions used for each of the pathways evaluated.

Reference doses (RfDs) have been developed by U.S. EPA for indicating the potential for adverse health effects from exposure to chemicals exhibiting non-carcinogenic effects. RfDs, which are expressed in units of mg/kg-day, are estimates of lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals from environmental media (e.g., the amount of a chemical ingested from contaminated drinking water) can be compared to the RfD. RfDs are derived from human epidemiological studies or animal studies to which uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans). These uncertainty factors help ensure that the RfDs will not underestimate the potential for adverse non-carcinogenic effects to occur.

Potential concern for non-carcinogenic effects of a single contaminant in a single medium is expressed as the hazard quotient (HQ) (the ratio of the estimated intake derived from the contaminant concentration in a given medium to the contaminant's reference dose). By adding the HQs for all contaminants within a medium or across all media to which a given population may reasonably be exposed, the Hazard Index (HI) can be generated. The HI provides a useful reference point for gauging the potential significance of multiple contaminant exposures within a single medium or across media. Any Hazard Index value greater than 1.0 suggests that a non-carcinogen potentially presents an unacceptable health risk.

Table 9 lists the total Hazard Indices for the pathways considered. As the table indicates the following scenarios' Hazard Indexes exceed 1.0:

- Direct contact with soil by current and future on-site workers (HI=24.9), future residential adults (29.2) and children (63.9), and workers on an adjacent property (13.9);
- Ingestion of soil by current and future on-site workers (1.89), future residential adults (4.46) and children

PARAMETERS USED IN RISK EQUATIONS

Pathway	Parameter	On-site Worker	Off-site Children	Residential Adults	Residential Children	Adjacent Worker	Children (Riverside School)
Inhalation of fugitive Dust	IR = Inhalation Rate (m ³ /hr)	3.0	1.25	1.25	1.25	3.0	1.25
	C = Chemical Concentration (mg/m ³)	Chemical Specific					
	EI = Exposure Time (hours/day)	8	3	24	24	8	6
	ED = Exposure Duration (days)	6,975	124	10,950	3,285	6,975	124
	BW = Body Weight (kg)	70	25	70	25	70	25
	LI = Lifetime (years)	70	70	70	70	70	70
	AI = Averaging Time (days)	45 years	4 years	30 years	9 years	45 years	6 years
Direct Contact with Soil	C = Contaminant Concentration (mg/kg)	Chemical Specific					
	Cf = Conversion Factor (10 ⁶ kg/mg)		-				
	SA = Surface Area Available for Contact (cm ²)	3,120	-	4,050	3,160	3,120	-
	AF = Soil to Skin Adherence Factor (mg/cm ²)	2.11	-	2.11	2.11	2.11	-
	ABS = Absorption Factor (unitless)(VOCs, SVOCs, Inorganics)	0.25, 0.10, 0.01	-	0.25, 0.10, 0.01	0.25, 0.10, 0.01	0.25, 0.10, 0.01	-
	EF = Exposure Frequency (event/year)	155	-	140	140	155	-
	ED = Exposure Duration (years)	45	-	30	9	45	-
	BW = Body Weight (kg)	70	-	70	25	70	-
	LI = Lifetime (years)	70	-	70	70	70	-
Ingestion of On Site Surface Soils	CR = Soil Consumption Rate (g/day)	0.1	-	0.1	0.2	0.1	-
	C = Concentration of Contaminant in Soil (mg/kg)	Chemical Specific					
	ED = Exposure Duration (days)	6,975	-	10,950	2,190	6,975	-
	BW = Body Weight (kg)	70	-	70	16	70	-
	LI = Lifetime (yr)	70	-	70	70	70	-
	AI = Averaging Time (days)	6,975	-	10,950	2,190	6,975	-
Direct Contact with Surface Water	C = Contaminant Concentration (mg/l)	Chemical Specific					

Pathway	Parameter	On-site Worker	Off-site Children	Residential Adults	Residential Children	Adjacent Worker	Children (Riverside School)
	SA = Surface Area of Skin Contacted (cm ²)	-	11,600	19,400	11,600	-	-
	PC = Dermal Permeability (8.4 x 10 ⁻⁴ cm/hr)	-	8.4 x 10 ⁻⁴	8.4 x 10 ⁻⁴	8.4 x 10 ⁻⁴	-	-
	ET = Exposure Time (hours/day)	-	2.6	2.6	2.6	-	-
	EF = Exposure Frequency (days/year)	-	28	14	28	-	-
	ED = Exposure Duration (years)	-	9	30	9	-	-
	CF = Conversion Factor (1 L/1000 cm ³)	-				-	-
	BW = Body Weight (kg)	-	25	70	25	-	-
	LT = Lifetime (years)	-	70	70	70	-	-
	AT = Averaging Time (days)	-	9 years	30 years	9 years	-	-
	C = Contaminant Concentration (mg/kg)	Chemical Specific					
Direct Contact with Sediments	CF = Conversion Factor (10 ⁻⁶ kg/mg)	-			-	-	-
	SA = Surface Area Available for Contact (cm ²)	-	1,080	820	1,080	-	-
	AF = Soil to Skin Adherence factor (mg/cm ²)	-	2.11	2.11	2.11	-	-
	ABS = Absorption Factor (unitless) (VOCs, SVOCs, Inorganics)	-	0.25, 0.10, 0.01	0.25, 0.10, 0.01	0.25, 0.10, 0.01	-	-
	EF = Exposure Frequency (days/year)	-	28	14	28	-	-
	ED = Exposure Duration (years)	-	9	30	9	-	-
	BW = Body Weight (kg)	-	25	70	25	-	-
	LT = Lifetime (years)	-	70	70	70	-	-
	AT = Averaging Time (days)	-	9 years	30 years	9 years	-	-
	C = Contaminant Concentration (mg/L)	Chemical Specific					
Incidental Ingestion of Surface Water	CR = Contact Rate (L/hr)	-	0.05	0.05	0.05	-	-
	ET = Exposure Time (hours/day)	-	2.6	2.6	2.6	-	-
	EF = Exposure frequency (days/year)	-	28	14	28	-	-
	ED = Exposure Duration (years)	-	9	30	9	-	-

TABLE 3 (continued)

Pathway	Parameter	On-site Worker	Off-site Children	Residential Adults	Residential Children	Adjacent Worker	Children (Riverside School)
Ingestion of Ground Water	BW = Body weight (kg)	-	25	70	25	-	-
	LT = Lifetime (years)	-	70	70	70	-	-
	AT = Averaging Time (days)	-	9 years	30 years	9 years	-	-
	CR = Water Consumption Rate (L/Day)	2	-	2	1	-	-
	C = Contaminant Concentration (mg/L)	Chemical Specific					
	ED = Exposure Duration (days)	11,700	-	10,950	3,285	-	-
	BW = Body Weight (kg)	70	-	70	25	-	-
	LT = Lifetime (yr)	70	-	70	70	-	-
	AT = Averaging Time (days)	11,700	-	10,950	3,285	-	-

TABLE 9
SUMMARY OF RISKS* TO HUMANS FOR ALL EXPOSURE SCENARIOS
AND LAND USE CONDITIONS AT SITE

Scenario Number	Scenario Description		Land Use	ELCR ^a	HI ^a
	Exposure Pathway	Receptors			
1a	Inhalation of contaminated dust	On-site workers ^c	CFT ^a	2.20 E-5 ^b	1.44 E-2
1b		Children in the park		3.14 E-9	2.31 E-5
1c		Adjacent site workers ^c		2.37 E-6	1.55 E-3
1d		On-site adults ^c	FR ^a	4.31 E-5	4.23 E-2
1e		On-site children ^c		3.62 E-5	1.18 E-1
1f		Children at school, school hour exposure	CI ^a	4.66 E-9	2.28 E-5
1g		Children at school, 24 hour exposure		2.72 E-8	3.57 E-3
2a	Direct contact with soil	On-site workers ^c	CFI	1.74 E-4	2.49 E+1
2b		On-site adults ^c	FR	1.36 E-4	2.92 E+1
2c		On-site children ^c		8.93 E-5	6.39 E+1
2d		Zenith auto parts workers ^c	CFI	2.75 E-3	1.39 E+1
3a	Ingestion of soil	On-site workers ^c	CFI	1.10 E-5	1.89 E+0
3b		On-site adults ^c	FR	1.72 E-5	4.46 E+0
3c		On-site children ^c		3.02 E-5	3.90 E+1
3d		Zenith auto parts workers ^c	CFI	6.04 E-5	1.05 E+0
4a	Direct contact with surface water	On-site adults	FR	2.12 E-9	4.35 E-2
4b		On-site children	CFI	2.13 E-9	1.10 E-1
4c		Off-site children (Grand River)		0.00 E+0	2.22 E-2
5a	Direct contact with sediments	On-site adults	FR	2.39 E-7	6.65 E-2
5b		On-site children	CFI	5.28 E-7	4.91 E-1
5c		Off-site children (Grand River)		0.00 E+0	2.51 E-2
6a	Incidental ingestion of surface water	On-site adults	FR	2.14 E-9	1.07 E-2
6b		On-site children	CFI	3.59 E-9	5.99 E-2
6c		Off-site children (Grand River)		0.00 E+0	5.87 E-3
7d	Ingestion of ground water	On-site workers ^c	FI ^a	1.67 E-4	3.86 E+0
7e		On-site adults ^c	FR	3.12 E-4	1.08 E+1
7f		On-site children ^c		1.31 E-4	1.52 E+1

* Does not include risk from exposure to lead and PAHs at the site

^a Excess lifetime cancer risk (ELCR) ^a Hazard index (HI)

^a Current and future industrial (CFT) use of the site ^a Future residential (FR) use of the site

^a Current industrial (CI) use of the site ^a Future industrial (FI) use of the site

^a "2.20 E-5" implies 2.20×10^{-5} ; "2.20 E+0" implies 2.20; "2.20 E-5" implies 2.20×10^{-5} , and so on

^a Exposure scenario with excess lifetime cancer risk (ELCR) in excess of 1.00×10^{-4}

^a Exposure scenario with hazard index (HI) more than 1.0

(39.0), and current and future workers on an adjacent property (1.05); and,

- Ingestion of groundwater by future on-site workers (3.86) and future residential adults (10.8) and children (15.2).

Cancer potency factors (CPFs) have been developed by U.S. EPA's Carcinogenic Assessment Group for estimating excess lifetime cancer risks associated with exposure to potentially carcinogenic chemicals. CPFs, which are expressed in units of (mg/kg-day)⁻¹, are multiplied by the estimated intake of a potential carcinogen, in mg/kg-day, to provide an upper-bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The term "upper bound" reflects the conservative estimate of the risks calculated from the CPF. Use of this approach makes underestimation of the actual cancer risk highly unlikely. Cancer potency factors are derived from the results of human epidemiological studies or chronic animal bioassays to which animal-to-human extrapolation and uncertainty factors have been applied (e.g., to account for the use of animal data to predict effects on humans).

Excess lifetime cancer risks are determined by multiplying the intake level with the cancer potency factor for each contaminant of concern. These risks are probabilities that are generally expressed in scientific notation (e.g. 1×10^{-6} or $1E-6$). An excess lifetime cancer risk of 1×10^{-6} indicates that, as a plausible upper bound, an individual has a one in one million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at a site. The U.S. EPA generally attempts to reduce the excess lifetime cancer risk posed by a Superfund sites to a range of 1×10^{-4} to 1×10^{-6} (1 in 10,000 to 1 in 1 million), with an emphasis on the lower end of the scale (1×10^{-6}).

Table 9 indicate the excess lifetime cancer risks for different scenarios. As the table shows several scenarios exceed the acceptable Excess Lifetime Cancer Risks as described above. The following bullets summarize the major carcinogenic risks at the site:

- Direct contact with soils by off-site workers¹ (3×10^{-3}), future residential adults 1×10^{-4} .

¹As defined in the RI and FS, "off-site" means the area outside of the originally fenced portion of the H. Brown Company, Inc. property. It should not be construed to mean "off-site" as referred to in the NCP.

- Ingestion of groundwater by residential adults 3×10^{-4} .

Evaluation of Potential Health Risks from Lead

In addition to the above analysis, the U.S. EPA Biokinetic Uptake Model (Lead Model) was used in the risk assessment to approximate blood-lead (PbB) levels in children exposed to lead contamination on or from the H. Brown site. This Lead Model was developed by U.S. EPA because the noncarcinogenic effects of lead in infants and young children do not appear to exhibit a threshold, i.e. there is no evidence of a dose or exposure level of lead below which no adverse effects are observed. An RfD is generally based on no observable effect level (NOEL). Because there may be no NOEL for some of the adverse neurobehavioral effects of lead, an RfD may not be appropriate for evaluating effects of lead.

PbB levels calculated using the Lead Model were compared with a 10 microgram-per-decaliter ($\mu\text{g}/\text{dl}$) benchmark or cutoff value. Levels equal to, or greater than this may produce adverse effects which may be sufficiently significant to warrant regulatory action. This is considered a level of concern and should not to be confused with a threshold, because adverse effects may be associated with levels less than 10 $\mu\text{g}/\text{dl}$.

Two different analyses were performed using the Lead Model. The first considered the contribution of lead on the H. Brown site to air concentrations of lead at the Riverside Public School (located across the Grand River, approximately two blocks away) and the resulting effect on PbB in a population of children living near the school. The other analysis considered the effect of site lead concentrations on a population of children living on the site, because there is the potential for future residential use of this property.

When the default parameters are used in the model--that is, when only typical concentrations of lead are assumed with no contribution from a significant source such as the H. Brown site ($0.200 \mu\text{g lead}/\text{m}^3$)-- 6 in 10,000 children would be expected to exhibit PbB above the 10 $\mu\text{g}/\text{dl}$ cut-off level.

The air lead concentrations measured on-site ($7.4 \mu\text{g lead}/\text{m}^3$) would put nearly 1 in 1,000 children at risk of exhibiting PbB levels above the cut-off.

If the lead concentrations measured in all on-site media (soil, air, and groundwater) are used in place of the model default parameters, 100% of the children living on-site would be expected to achieve PbB above the 10 $\mu\text{g}/\text{dl}$ cut-off level. It should be noted in this case that at the high concentrations of lead measured on-site, it is actually not possible to accurately

predict the resulting PbB levels. Because the red blood cells read a saturation concentration at high intake levels, the predicted levels may not be physically possible.

In summary, children living in the vicinity of the Riverside Public School may not be at significantly greater risk of achieving PbB levels above the 10 $\mu\text{g}/\text{dl}$ cut-off as a result of wind-borne dispersion of lead from the H. Brown site. Children living on-site would, however, be at significantly greater risk based on measured air concentrations alone.

-Environmental Risks

A qualitative review of risks posed to wildlife by contaminated materials from the site was performed as part of the investigation. The pathways evaluated included ingestion and direct contact with surface water; direct contact with sediments; and direct contact with, and ingestion and inhalation of surface soil. Due to the high levels and nature of the contaminants found at the H. Brown site, wildlife having repeated and prolonged exposure to contaminated materials may be at risk in each of the pathways examined. Concentrations of lead in the river are not expected to result in overt toxicity to aquatic or other species, with the possible exception of potentially localized effects just downstream of the Cogswell drain outfall.

Elevated concentrations of lead, and the associated toxic metals antimony and cadmium, could potentially produce toxic effects in any aquatic species that could inhabit the wetland. Because the wetland area is isolated, ephemeral, located within a larger industrial area, and is separated from the river by the highway, the wildlife population density in this area is currently very low. The wetland area is not expected to be used for agricultural purposes. These factors will help to limit the effects of contaminant concentrations on an ecosystem scale. If wildlife were to come into contact with site surface water or sediments, concentrations of lead and other site contaminants are likely to contribute significantly to the heavy metal body burdens of resident species, with potentially adverse effects.

Based upon the risks summarized above, actual or threatened releases of hazardous substances from this site, if not addressed by implementation of the response action selected by this ROD may present an imminent and substantial endangerment to public health, welfare, or the environment, primarily through use of contaminated groundwater. The site may also pose risks to non-human receptors from contaminants released from the site into surface waters and the wetlands.

7. Rationale for Further Action

Actual or threatened releases of hazardous substances from this site, if not addressed by implementation of the response action selected by this ROD, may present an imminent and substantial endangerment to public health, welfare, or the environment. Therefore, based on the findings in the RI report and the discussion above, a Feasibility Study (FS) was performed to focus the development of alternatives to address the threats at the site. The FS report documents the evaluation of the magnitude of site risks, site-specific applicable or relevant and appropriate requirements, and the requirements of CERCLA and the NCP in the derivation of remedial alternatives for the H. Brown site.

8. Description of Alternatives

The ten cleanup alternatives evaluated for the H. Brown site are presented below. More detailed information on these cleanup alternatives is available in the Feasibility Study Report.

Common Elements

With the exception of Alternative 1, the remaining nine alternatives considered for the H. Brown site include a number of common elements:

- Demolishing buildings -- Demolition and removal of two contaminated buildings would be required because the soil under the buildings is expected to be contaminated. These materials will either be disposed of on-site, or sent to an appropriate off-site landfill.
- Consolidating surface soil -- Contaminated surface soil would be moved to the area where subsurface soil cleanup would be required.
- Collecting, treating, discharging and monitoring groundwater -- Contaminated groundwater from the shallow aquifer would be collected through a series of underground drainage ditches, treated to meet state and federal water quality standards, and then discharged to the Grand River. Treatment will include aeration, filtration, carbon adsorption, and ion exchange. Residue from the treatment process will be disposed of off-site in an appropriate facility. It is estimated that treatment of the shallow groundwater should take one year to complete. Additional wells would be installed to determine the nature and extent of contamination of the intermediate and deep aquifers and to monitor the effectiveness of the remedy.

- Collecting, treating, and disposing of surface water and sediments from the wetlands, sewer system and drainage ditches -- Surface water from the sewer system, wetlands, and drainage ditches would be treated and discharged along with groundwater. Contaminated sediments would be treated and disposed along with the contaminated soil.
- Restricting site use -- Restrictions would be placed on the use of the site and the groundwater during and after cleanup activities.
- Restricting site access -- Maintain a fence around the site to limit access.

Alternative 1: No Action

The Superfund program requires that a no-action alternative be considered at every site. It is used for comparison during the evaluation of the other alternatives. Under this alternative, no action would be taken to cleanup the site. This alternative does include a review every five years to determine the need for additional action.

Capital Cost:	NONE
Annual Operation and Maintenance (O&M) Cost:	NONE
Present Worth (30 Year):	NONE
Time to Implement:	NONE

Alternative 7: Soil Containment, Groundwater Treatment, and Drainage Remediation

Under this alternative, soil requiring remediation would be consolidated on-site, surrounded by a containment wall to prevent migration of groundwater through the waste, and then covered with a multi-component clay cap which would be designed to comply with state and federal hazardous waste regulations. The cap would consist of a three foot thick layer of compacted clay, a layer of compacted soil to protect the cap from frost damage, a drainage layer, and a one foot thick vegetated layer. A fence would be constructed around the area to prevent access.

Capital Cost:	\$4,800,000
Annual Operation and Maintenance (O&M) Cost:	\$220,000
Present Worth (30 Year):	\$6,900,000
Time to Implement:	9 - 18 Months

Alternative 8: Pilot Scale Treatment and Containment, Groundwater Treatment and Drainage Remediation

As part of this alternative a soil treatment system, which uses an acid leaching process to remove lead from the soil, would be

tested in pilot-scale equipment. This process involves washing the contaminated soil with an acid solution, precipitating out the dissolved lead and then sending the lead to a smelter for recovery. If it is effective, full-scale treatment of the soil under Alternative 10 or 12 would take place. If the treatment process is ineffective a containment wall would be constructed surrounding the contaminated subsurface soil. A multi-layer cap meeting state and federal ARARs for hazardous waste would be placed on the site to prevent exposure to contaminated soil and minimize the infiltration of precipitation through waste and into the groundwater. The cap would consist of a three foot thick layer of compacted clay, a layer of compacted soil to protect the cap from frost damage, a drainage layer, and a one foot thick vegetated layer. A fence would be constructed around the cap to prevent access to the area.

For purposes of evaluating this alternative it was assumed that the soil treatment system was ineffective and the contaminated soil is to be contained on-site.

Capital Cost:	\$5,100,000
O&M Cost:	\$220,000
Present Worth:	\$7,200,000
Time to Implement	9-18 Months

Alternative 9: Soil Disposal, Groundwater Treatment, and Drainage Remediation

In addition to the common activities discussed above, this alternative involves transporting soil contaminated above 500 ppm of lead (approximately 180,000 cy) to an approved off-site hazardous waste landfill. The excavated areas would be backfilled with clean soil from off-site sources.

Capital Cost:	\$41,000,000
Annual O&M Cost:	\$180,000
Present Worth:	\$41,000,000
Time to Implement:	18-24 Months

Alternative 10: Pilot and Full-Scale Soil and Groundwater Treatment and Drainage Remediation

As part of this alternative, some soil from the site would be treated by the acid-leaching process on a pilot-scale basis, as discussed in Alternative 8. Assuming the soil treatment system is effective all soil requiring remediation (above 500 ppm of lead, approximately 180,000 cy) would be treated by the acid-leaching process. The treated soil would be backfilled on-site and covered with a clay cap designed to comply with state and federal solid waste regulations. The cap would consist of two feet of compacted clay, a drainage layer, a layer of compacted soil to protect the cap from frost damage, and a vegetated layer.

) This cap would prevent exposure to any residual contamination and reduce infiltration of precipitation into the soil. A fence would be constructed around the cap to prevent access to the site.

Capital Cost:	\$22,000,000
Annual O&M Cost:	\$220,000
Present Worth:	\$24,000,000
Time to Implement:	2-4 Years

Alternative 11: Soil Smelting and Disposal, Groundwater Treatment, and Drainage Remediation

In addition to the common elements discussed above, this alternative would include excavation of all of the contaminated soil. Soil with lead concentrations of more than 20,000 ppm of lead and PCB concentrations of less than 1.00 ppm (approximately 50,000 cubic yards) would be sent to a lead smelter to recover the lead. The remaining soil would be disposed of, off-site, in an approved hazardous waste landfill.

Capital Cost:	\$36,000,000
Annual O&M Cost:	\$20,000
Present Worth:	\$36,000,000
Time to Implement:	18-24 Months

Alternative 12: Soil Smelting and Treatment, Groundwater Treatment, and Drainage Remediation

This alternative is based upon the assumption that the acid-leaching process discussed in Alternative 8 cannot effectively treat soil contaminated with lead above a certain concentration. Initially, some soil will be treated in a pilot-scale test of the process to determine the range of concentration that could be cost-effectively treated. If the process is found to be completely ineffective, one of the other proposed alternatives would be implemented. Cost estimates were based upon the assumption that soil above 20,000 ppm lead (approximately 50,000 cy) could not be treated by the acid-leaching process and would be sent to a smelter for lead recovery. Excavated areas would be backfilled with clean soil. The site would then be covered with a clay cap that meets state and federal standards for solid waste landfill caps. The cap would consist of two feet of compacted clay, a drainage layer, a layer of compacted soil to protect the cap from frost damage, and a vegetated layer. This cap would prevent exposure to any residual contamination and reduce infiltration of precipitation into the soil. A fence would be constructed around the cap to prevent access to the site.

Capital Cost:	\$23,000,000
Annual O&M Cost:	\$220,000
Present Worth:	\$25,000,000
Time to Implement:	2-4 Years

Alternative 13: Soil Smelting and Containment, Groundwater Treatment, and Drainage Remediation

Under this alternative, all soil having more than 20,000 ppm of lead (approximately 50,000 cy) would be excavated and sent to a smelter to recover the lead. The excavated area would be backfilled with clean soil from off-site sources. A cap would be constructed to cover, and a containment wall constructed to surround, the remaining soil exceeding clean-up levels. A multi-layer cap meeting state and federal ARARs for hazardous waste would be placed on the site to prevent exposure to contaminated soil and minimize the infiltration of precipitation through waste and into the groundwater. The cap would consist of a three foot thick layer of compacted clay, a layer of compacted soil to protect the cap from frost damage, a drainage layer, and a one foot thick vegetated layer. This cap would prevent contact with the site soil and minimize infiltration of precipitation through the waste. A fence would be constructed around the cap to prevent access to the area.

Capital Cost:	\$9,600,000
Annual O&M Cost:	\$220,000
Present Worth:	\$12,000,000
Time to Implement:	2-3 Years

Alternative 14: Soil Smelting, Solidification and Containment, Groundwater Treatment and Drainage Remediation

Under this alternative, all soil having more than 20,000 ppm of lead (approximately 50,000 cy) would be excavated and sent to a smelter to recover the lead. Soil having less than 20,000 ppm but more than 500 ppm of lead (approximately 130,000 cy) would be solidified in place in a cement-like form. The excavated area would be backfilled with clean soil from an off-site source, surrounded by a containment wall, and then covered with a hazardous waste cap. The cap would consist of a three foot thick layer of compacted clay, a layer of compacted soil to protect the cap from frost damage, a drainage layer, and a one foot thick vegetated layer. The purpose of the cap is to prevent contact with, and minimize infiltration of precipitation through the solidified soil. The cap would also prevent damage to the solidified soils from frost and wet-dry cycles.

Capital Cost:	\$16,000,000
Annual O&M Cost:	\$220,000
Present Worth:	\$18,000,000
Time to Implement:	2-3 Years

Alternative 15: Solidification and Containment of Soil, Groundwater Treatment, and Drainage Remediation

Under this alternative, all soil requiring remediation (approximately 180,000 cy) would be solidified, in place, to cement-like form. The solidified soil would be surrounded by a containment wall and covered with a hazardous waste cap. The cap would consist of a three foot thick layer of compacted clay, a layer of compacted soil to protect the cap from frost damage, a drainage layer, and a one foot thick vegetated layer. The purpose of the cap would be to prevent contact with, and infiltration of precipitation through, the solidified soil. The cap would also prevent damage to the solidified soils from frost and continual wet-dry cycles.

Capital Cost:	\$13,000,000
Annual O&M Cost:	\$220,000
Present Worth:	\$15,000,000
Time to Implement:	2-3 Years

9. Comparative Analysis of Alternatives: The Nine Criteria

The following nine criteria, outlined in the NCP at 40 CFR 300.430(e)(9)(iii), were used to compare the alternatives and to determine the most appropriate alternative for remediation of the soils and groundwater contamination that is protective of human health and the environment, attains applicable or relevant and appropriate requirements (ARARs), is cost-effective and represents the best balance among the evaluating criteria. An alternative providing the "best balance" of trade-offs, with respect to the nine criteria, is determined from this evaluation.

The Nine Criteria

- Threshold Criteria:

Overall Protection of Human Health and the Environment addresses whether a remedy provides adequate protection and describes how risks posed by each exposure pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

Because the no action alternative does not provide adequate protection to human health and the environment, the no action alternative is not available for selection and will not be discussed through the remainder of this analysis.

All of the remaining alternatives offer protection to human health from risks related to exposure to contaminated soil or

groundwater at the site. All of the alternatives also protect the environment. Alternatives that would remove all soil requiring remediation from the site, such as Alternatives 9 and 11, would be protective of the environment for the long-term. Alternatives 14 and 15, which would solidify/stabilize all, or some, of the soil requiring remediation, pose some risk over the long-term if the solidified/stabilized matrix loses its integrity and contaminants leach to the groundwater. Alternatives 7, 8 and 13, which leave all or some soil requiring remediation at the site offer less effectiveness because contaminants left in the soil at the site may leach over time into the groundwater. Such leaching would contaminate the groundwater that may seep into the Grand River and may affect aquatic life.

Compliance with ARARs addresses how the proposed alternative complies with all applicable or relevant and appropriate requirements of federal and more stringent state environmental laws (ARARs). It also considers how the alternatives comply with advisories, criteria, or other guidance to be considered (TBCs) that do not have the status of laws, but that the U.S. EPA and the State have agreed are "appropriate" for protectiveness or to carry out certain actions or requirements, and/or provide grounds for invoking a waiver.

A summary of identified ARARs for the alternatives is included in Section 11 below. Only ARARs necessary for on-site remedial activities have been identified. The selected remedy will be designed to meet all applicable or relevant and appropriate requirements of federal and more stringent state environmental laws. In some instances, rules cited contain both substantive and procedural or administrative requirements. Only the substantive requirements are ARAR for the purpose of on-site activities. Examples of administrative or procedural requirements which are not considered ARAR include, but are not limited to, state approval requirements, reporting requirements, permit application requirements, and provisions in rules or statutes that list factors to be considered in selecting a remedial action alternative but do not set forth a "standard or level of control" for that action to meet.

All alternatives would comply with all ARARs for contaminated soil, groundwater, and air at the site. The major groundwater ARARs include the requirements of the federal Safe Drinking Water and Clean Water Acts and state Acts 245 and 307. Alternatives 7, 8, 13, 14, and 15 would comply with state Act 64 and federal Resource Conservation and Recovery Act (RCRA) requirements for capping of the waste. Alternatives 10 and 12 would comply with state Act 641 and RCRA requirements for capping. Those alternatives requiring off-site disposal or treatment of waste, or treatment by the acid washing method, would comply with RCRA Land Disposal Restrictions. Each of the alternatives requires excavation of sediments from the adjacent wetlands; therefore,

each alternative will have to meet the requirements of the Goemaere-Anderson Wetlands Protection Act of Michigan, and Executive Orders 11990 and 11988 (Wetlands Protection and Floodplain Management, respectively). In addition, each of the alternatives requires excavation, construction, or treatment activities which may result in the release of contaminants into the air. Each alternative must, therefore, comply with the air quality standards in the Clean Air Act and the Michigan Air Pollution Act.

Long-Term Effectiveness and Permanence refers to the magnitude of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup standards have been met.

Alternatives 9, 10, 11, and 12 would either remove or treat, and Alternative 15 would solidify/stabilize and completely contain, all soil requiring remediation. Therefore, these alternatives would be most effective for the long term. The remediation of soil by Alternatives 9 through 12 would be permanent, whereas the remediation by Alternatives 14 and 15 would be effective for a long, but unknown period of time. The uncertain permanence of remediation under these alternatives results from the possible disintegration of the solidified/stabilized matrix over time. Assuming the most effective mixture of solidifying/stabilizing agents and waste is selected through studies, and proper construction of the containment components of the remedy is performed, the possibility of Alternatives 14 and 15 losing their integrity is remote.

Alternatives 7 and 8 would leave all contaminated soil on-site. Alternative 13 would leave all but the most contaminated soil on-site, sending the most contaminated to a smelter. The soil left on-site would have the potential to contaminate the groundwater because of the possible leaching of contaminants from the soil. Each of these alternatives would remain effective as long as the integrity of the cap and containment wall is maintained. Assuming good construction quality of the containment components, the possibility of them losing their integrity over time is remote.

Reduction of Toxicity, Mobility, or Volume of Contaminants Through Treatment is the anticipated performance of the treatment technologies a remedy may employ.

All alternatives would reduce toxicity, mobility, or volume of contaminants in the groundwater by removing and treating the contaminants. The maximum reduction is offered by Alternatives 10, 12, 14 and 15, because each would treat or solidify/stabilize the contaminated soil. Alternatives 11 and 13 would partially reduce the toxicity, mobility, and volume of contaminants in the soil, because only a portion of the contaminated soil would be

treated at a smelter. Alternatives 14 and 15 would not reduce the toxicity, but they would significantly reduce the mobility of the contaminants. Under alternative 15, the volume would actually increase because of the solidification/stabilization process. Neither Alternative 7 or 8 meets this criterion because neither involves treatment of the soil.

Short-Term Effectiveness refers to the speed with which the remedy achieves protection, as well the remedy's potential to create adverse impacts on human health and the environment that may result during the construction and implementation period.

All of the alternatives would pose some short-term risks during implementation. Alternative 7 is expected to have the most significant short-term risks because of the difficulty associated with constructing the containment walls. This construction involves welding synthetic sheets together inside a trench. Alternative 8 is expected to have the least significant risk, because it only involves the excavation of soil to construct subsurface drains and removal of soil. The other alternatives would have nearly the same level of short-term risks.

Those alternatives that are most quickly implemented and based upon proven and easily available technologies would provide greater short-term effectiveness. Alternatives 8, 10, and 12 require pilot-scale testing before implementing the rest of the alternative; they would have a relatively low degree of short-term effectiveness. Alternatives 7, 8, 14, and 15 would have the greatest short-term effectiveness because they involve proven and easily available containment or solidification/stabilization technologies. Alternatives 9 and 11, which require disposal or treatment in an off-site facility, would deliver only a moderate degree of short-term effectiveness because of the possibility in delays due to capacity or regulatory problems.

On-site workers involved with the excavation and/or treatment of soil, in each of the alternatives, would be exposed to contaminated soil and dust. Some off-site individuals may also be exposed to the contaminated dust. Risks from such exposures would be minimized by providing protective equipment to workers and taking dust control measures.

Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the chosen solution.

Alternatives 7 and 15 would be the easiest to implement because vendors are readily available and do not require pilot-scale studies or rely on off-site treatment or disposal. Alternatives 8, 10 and 12 would be more difficult to implement than other alternatives, primarily because the equipment for treating the soil would have to be originally designed and fabricated, or

pilot-scale testing would be required to determine whether full-scale treatment is possible. Alternatives 9, 11, 12, 13, and 14 would be somewhat difficult to implement, because of the need for regulatory determination of compliance for the receiving facility and the potential for capacity problems as they involve constructing a containment wall and a cap.

Cost

Cost includes estimated capital, operation and maintenance, and present net worth costs. Table 14 lists the cost for each of the alternatives.

Table 10
Estimated Cost

Alternative	Capital Cost (\$)	Operation and Maintenance (\$)	Present Net Worth (\$)
1	NONE	NONE	NONE
7	4,800,000	220,000	6,900,000
8	5,100,000	220,000	7,200,000
9	41,000,000	180,000	41,000,000
10	22,000,000	220,000	24,000,000
11	36,000,000	20,000	36,000,000
12	23,000,000	220,000	25,000,000
13	9,600,000	220,000	12,000,000
14	16,000,000	220,000	18,000,000
15	13,000,000	220,000	15,000,000

-Modifying Criteria:

State Acceptance indicates whether, based on its review of the RI/FS and Proposed Plan, the State concurs with, opposes, or has no comment on the preferred alternative.

The State of Michigan has assisted in the development and review of the Administrative Record. The State's position regarding the selected alternative is discussed in its concurrence letter. The State is expected to concur on the remedy.

Community Acceptance The specific comments received and U.S. EPA's responses are outlined in the attached Responsiveness Summary.

10. Selected Remedy

Based upon considerations of the requirements of CERCLA, the NCP and balancing of the nine criteria, the U.S. EPA has determined that Alternative 15, Solidification and Containment of Soil, Groundwater Treatment, and Drainage Remediation, is the most appropriate for the H. Brown site.

The components of the selected remedy are as follows:

1. Access Restrictions

- a. Temporary and/or permanent fences and signs will be erected and maintained around the site and pretreatment/treatment systems as specified by the U.S. EPA.
- b. Pursuant to Michigan Act 307, institutional controls including, but not limited to, notice to future property owners of contamination at the site, deed restrictions to regulate the development of the H. Brown site, and groundwater use restrictions in the areas that have contaminated groundwater will be sought. Groundwater use restrictions may be rescinded after remediation standards are met and proven to be maintained.

The purpose of these restrictions is to prevent exposure to site contaminants, prevent erosion of the cap, and provide security for the remedial action equipment.

2. Site Monitoring

Groundwater and surface water monitoring. Groundwater aquifers and surface waters and sediments in the site vicinity will be sampled and analyzed periodically to monitor chemical contaminant levels during site remediation.

Monitoring shall include shallow, intermediate, and bedrock aquifers beneath the site. Sampling and analysis will include existing groundwater monitoring wells and additional groundwater monitoring wells.

3. Building Demolition/Decontamination

Buildings located on the site above soil requiring remediation will be demolished and disposed of on-site or in an appropriate off-site landfill. Buildings not requiring demolition shall be properly decontaminated to meet state or federal standards. All buildings will also be tested to assure that they have been properly decontaminated.

4. Soil Consolidation

Contaminated soils exceeding cleanup standards will be consolidated on-site to the area where soil solidification/stabilization will be performed. This area will be located above the clay confining layer. Testing will be conducted to assure that all soil requiring treatment has been consolidated to the area referred to above. Excavated areas will be backfilled with clean soil from off-site sources.

5. In Situ Solidification/Stabilization of Contaminated Soils/Sediments

All soils/sediments exceeding cleanup standards will be solidified/stabilized by an in situ solidification/stabilization process, to reduce the mobility of contaminants in the soil. EPA expects that the solidified/stabilized mass will meet Toxicity Characteristic Leaching Procedure (TCLP) standards, as specified in 40 CFR Part 268, Appendix I and for each extraction of the Multiple Extraction Procedure (MEP), ("Test Methods for Evaluating Solid Waste, Physical/Chemical Methods", Method 1320 SW-846). Testing will be performed to assure that the most protective solidifying/stabilizing agent is used to achieve maximum long-term structural and chemical integrity of the solidified/stabilized matrix. Once treatment is complete, EPA expects that the waste will no longer be RCRA characteristically hazardous.

6. Containment Wall

A containment wall will be constructed around the treated soil/sediment. The wall will extend vertically from the ground surface down to the clay confining layer beneath the treated soil so as to prevent groundwater from coming in contact with the treated mass. The wall will have a permeability equal to, or less than, the treated mass.

Sampling and testing of the containment wall will be performed to ensure that the wall will maintain adequate impermeability over time to protect the treated mass from groundwater infiltration.

7. Cap Construction

A cap will be constructed on the site so that it complies with Michigan Act 64. The cap will consist of a 12 inch vegetative soil layer, > 12 inch drainage layer, 3 feet of compacted clay, and maximum and minimum slope.

A Michigan Act 64 cap is considered protective for this site, because it would provide protection against direct contact with waste at the site, act as a significant barrier to infiltration of precipitation, and protect the solidified/stabilized mass from damaged due to freeze-thaw conditions. The waste is in direct hydraulic connection with the shallow groundwater.

8. Groundwater/Surface Water Collection, Treatment and Discharge

Both contaminated groundwater and surface water will be collected, treated, and discharged to the on-site surface waters. It is anticipated that discharge to the Turner Avenue sewer will be feasible. If it is not feasible, treated liquids will be discharged directly to the Grand River. A groundwater extraction/collection system will be installed to collect for treatment the contaminated groundwater in the shallow aquifer beneath the site. Collected groundwater and surface water will be pumped to an aboveground storage tank before being treated and then discharged to the Grand River. Groundwater will be extracted until the remediation standards of Table 14 are achieved at the point of compliance. The point of compliance for the groundwater remediation standards is the boundary of the final landfill cover. Contaminated groundwater and surface water will be extracted until the cleanup standards listed in table 14 are met. Extracted groundwater will be treated on-site through aeration, filtration, carbon adsorption, and ion exchange to meet NPDES permit standards prior to discharge to the Grand River. Such a treatment system will be required to meet the substantive requirements under, but not limited to the Clean Air Act, Clean Water Act, RCRA, and any more stringent state standards. If feasible, The treated liquids would then be discharged to the Turner Avenue sewer. The discharge would comply with the substantive requirements of an NPDES permit. If discharge to the sewer is not feasible, treated liquids will be discharged directly to the Grand River, and would comply with all NPDES permitting requirements.

Additional studies on the nature and extent of the groundwater contamination will be performed during the Remedial Design phase of the project. The purpose of these studies will be to further define background levels in the shallow aquifer and to more fully define the nature and extent of contamination in the intermediate and bedrock aquifers beneath the site. The results of these studies will be used along with information from the Remedial Investigation to determine whether the site is the source of the contaminants in the intermediate or bedrock aquifers and if contaminant levels exceed that are protective of human health and the environment. If those contaminant levels are determined to be site related and found

not to be protective in either of the aquifers, alternatives for remediation will be analyzed.

The goal of this remedial action is to restore the groundwater in the upper aquifer to its beneficial use and to protect against current and future exposures. Specifically, the groundwater will be collected until the cleanup standards are met at the point of compliance.

Based upon information obtained during the RI and FS, the U.S. EPA believes that the selected remedy will meet these goals. It may become apparent during implementation or operation of the groundwater extraction/collection system, that contaminant levels cease to decline and are remaining constant at levels higher than the remediation standards in Table 14 over some portion of the contaminant plume. In such a case, or if other circumstances necessitate the system performance standards, the system design, and/or the remedy may be reevaluated.

9. Surface Water and Sediments

Surface water and sediments from the wetlands adjacent to the site, the drainage ditches leading to the Grand River, and the sewer system running along Turner Avenue, that exceed the cleanup standards in Tables 12 and 14 will be collected and treated along with the consolidated soils and contaminated groundwater as discussed above.

10. Other Provisions

Mitigative measures will be taken during remedy construction activities to minimize the impacts of noise, dust, and erosion run-off to the surrounding community and environs. Fugitive dust emissions will not violate the National Ambient Air Quality Standard for particulate matter smaller than 10 microns (PM-10). Potential runoff, silting, and sedimentation problems from construction will be mitigated to comply with Michigan Acts including Public Acts 203 (1979), 346 (1972) and 347 (1972) for wetland protection, inland lakes and streams, and soil erosion and sedimentation control, respectively. Because excavation and/or filling in the wetland area adjacent to the site will take place the selected remedy will comply with the Wetland Management Executive Order 11990, and Michigan's Goemnere-Anderson Wetland Protection Act, Act 203 of 1979.

The solidified/stabilized waste will continue to be contained on-site. Because this solidified/stabilized waste is the source of the contaminants, hazardous constituents will therefore remain at the site. A review of site conditions will be conducted every five years after the initiation of the remedial action.

11. Statutory Determinations

The selected remedy must satisfy the requirements of Section 121 (a) through (f) of CERCLA to:

1. Protect human health and the environment;
2. Comply with ARARs or justify a waiver;
3. Utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable; and
4. Satisfy a preference for treatment that reduces toxicity, mobility, or volume as a principle element of the remedy.

The implementation of the selected alternative at the H. Brown Co., Inc. site satisfies these requirements of CERCLA Section 121 as follows:

a. Protection of Human Health and the Environment;

Implementation of the selected alternative will reduce and control potential risks to human health posed by exposure to contaminated soil and groundwater. Solidification/stabilization and containment of all soil exceeding cleanup standards will permanently reduce and control existing and potential risks, through treatment and engineering controls. Extraction and treatment of contaminated groundwater to meet groundwater remediation standards will reduce the potential excess lifetime cancer risk and non-carcinogenic risks due to ingestion of contaminated groundwater.

Institutional controls will provide short-term effectiveness for the prevention of drinking contaminated groundwater until the groundwater remediation standards are met. The selected remedy also protects the environment by reducing the potential risks posed by site chemicals discharging to surface water (Grand River) and the adjoining wetlands.

Capping the site, in addition to reducing any potential further risk posed by exposure to site contaminants, will reduce precipitation infiltration through the cap and maintain that reduction over time. The cap will reduce ground-water contaminant loading to the aquifer, allowing the restoration of the aquifer within a reasonable time frame. No unacceptable short-term risks will be caused by implementation of the remedy. The community and site workers may be exposed to noise and dust nuisances during construction of the cap and solidification/stabilization of the soils. Mitigative measures will be taken during remedy construction activities to minimize impacts of construction upon the surrounding community and environs.

b. Compliance with ARARs

The selected remedy will comply with the federal and/or state, where more stringent, applicable or relevant and appropriate requirements (ARARs) listed below:

1. Chemical-specific ARARs

Chemical-specific ARARs regulate the release to the environment of specific substances having certain chemical characteristics. Chemical-specific ARARs typically determine the extent of clean-up at a site.

Federal ARARs

Safe Drinking Water Act MCLs and MCLGs - Maximum Contaminant Levels (MCLs) and, to a certain extent, non-zero Maximum Contaminant Level Goals (MCLGs), the Federal Drinking Water Standards promulgated under the Safe Drinking Water Act (SDWA) are applicable to municipal drinking water supplies servicing 25 or more people. At the H. Brown site, MCLs and MCLGs are not applicable, but are relevant and appropriate, because the aquifer is a Class II aquifer which is presently being used as a drinking water source in the area surrounding the site and could potentially be used in the area of concern. MCLGs are relevant and appropriate when the standard is set at a level greater than zero (for non-carcinogens); otherwise, MCLs are relevant and appropriate. The point of compliance for federal drinking water standards is at the boundary of the solidified/stabilized waste, because this is the point where humans could potentially be exposed to contaminated groundwater. Because this site will have a final clay cover, the point of compliance will be at the boundary of the final cover.

Clean Water Act Section 304 - Surface water quality standards for the protection of human health and aquatic life were developed under section 304 of the Clean Water Act (CWA). The federal Ambient Water Quality Criteria (AWQC) are nonenforceable guidelines that set pollutant concentration limits to protect surface waters that are applicable to point source discharges, such as from industrial or municipal wastewater streams. At a Superfund site, the federal AWQC would not be applicable except for pretreatment requirements for discharge of treated water to a Publicly Owned Treatment Works (POTW). CERCLA (section 121(d)(1)) requires the U.S. EPA to consider whether AWQC would be relevant and appropriate under the circumstances of a release or threatened release,

depending on the designated or potential use of groundwater or surface water, the environmental media affected by the releases or potential releases, and the latest information available. Since the contaminated aquifer is a potential source of drinking water and since treated water will be discharged to the Grand River, AWQC adopted for drinking water and AWQC for protection of freshwater aquatic organisms are relevant and appropriate to the point source discharge of the treated water into the Grand River. Only the substantive NPDES permitting requirements will need to be met if discharge is allowed into the Turner Avenue sewer. If discharge is directly to the Grand River all NPDES requirements would be met because such discharge would be off-site.

Clean Air Act National Ambient Air Quality Standards 40 CFR 50 - These regulations provide air emission requirements for actions which may release contaminants into the air. As the selected remedy involves excavation, construction, and groundwater treatment activities which may release contaminants or particulates into the air, emission requirements promulgated under this act are relevant and appropriate.

State ARARs

Michigan Act 307 - The State of Michigan has identified the Michigan Environmental Response Act (referred to as "MERLA," "the Act," or "Act 307") and its implementing rules as ARARs for this site. U.S. EPA finds that only Rules 705(2) and (3), 707-715, 717(2), 719, and 723 qualify as ARARs in compliance with Section 121(d)(2) of CERCLA. These rules provide for the selection of a remedy which attains a degree of cleanup which conforms to one or more of three levels of cleanup - Type A, B, or C. A Type A cleanup generally achieves cleanup to background or non-detectable levels (R299.5707); a Type B level meets specified cleanup levels in all media (R299.5709-5715 and 5723), and a Type C cleanup is based on a site-specified risk assessment (R299.5717(2) and 5719(1)).

U.S. EPA's selected soil cleanup standards for this site are in compliance with Act 307 and its implementing rules in that they meet the standard for selection of a Type C (R 299.5717(2) and 5719(1)). The cleanup levels for contaminants in soil are determined by comparing current concentrations of contaminants with the background concentrations and with allowable concentrations based on (1) risks and (2) ARARs. Table

11 lists the representative chemicals found in the soil and the corresponding federal and state clean-up criteria which the U.S. EPA believes to be adequately protective of human health and the environment. Table 12 lists the soil remediation standards for the H. Brown site.

Current concentrations of individual contaminants are compared first with their background and ARAR-based allowable concentrations. The cleanup level for a contaminant is not proposed if its current concentration is lower than its background or ARAR-based allowable concentration. However, if the current concentration of a contaminant is higher than its background and ARAR-based allowable concentration, the cleanup level for the contaminant is set at the larger of the background and ARAR-based allowable concentrations. If the ARAR-based allowable concentration is not available for a contaminant, its current concentration is compared with its background and risk-based allowable concentrations and the cleanup level for the contaminant is not proposed if either of these concentrations are more than the current concentration of the contaminant. If the current concentration of a contaminant is more than its background or risk-based allowable concentrations, the cleanup level for the contaminant is set at the larger of the background or the risk-based allowable concentration for the contaminant.

U.S. EPA's selected groundwater cleanup standards for this site are in compliance with Act 307 and its implementing rules in that they meet the standard for selection of a Type A (R 299.5707)/Type B (R 299.5713). The numeric groundwater cleanup standards were derived by separately comparing current concentrations of contaminants in each aquifer with the corresponding background concentration and with allowable concentrations based on (1) risks and (2) ARARs.

TABLE 11

**COMPARISON OF CLEANUP LEVELS FOR SOIL WITH CURRENT, RISK-BASED,
ARAR-BASED, AND BACKGROUND CONCENTRATIONS OF
TARGET CONTAMINANTS (mg/kg)**

Target Contaminant (TC)	Concentration* (mg/kg)				
	Current	Risk	ARAR	Background	Cleanup
Antimony	1.19 E+3 ^a 6.60 E+2	1.00 E+0	5.00 E-1	ND ^c	5.00 E-1 (ARAR)
Arsenic	1.15 E+2 4.25 E+1	1.00 E+0	6.60 E+0	6.60 E+0	6.60 E+0 (Background)
Beryllium	1.14 E+0 5.60 E-1	1.00 E-2	Not Available	6.00 E-1	6.00 E-1 (Background)
Chromium	4.99 E+1 2.71 E+1	2.00 E+0	5.40 E+1	5.40 E+1	
Lead	1.30 E+5 1.99 E+5	Below Detection Limits	5.00 E+2	4.90 E+2	5.00 E+2 (ARAR)
BEHP	1.01 E+1 3.32 E+1	1.00 E+0	3.30 E-1	ND	3.30 E-1 (ARAR)
DDD	8.52 E-2 1.46 E-1	2.00 E-2	3.30 E-1	ND	
DDT	1.33 E-1 3.05 E-1	2.00 E-2	3.30 E-1	ND	
NNDPA	5.46 E+0 1.10 E+1	1.00 E+0	3.30 E-1	ND	3.30 E-1 (ARAR)
PCBs	5.48 E+0 1.35 E+1	1.00 E-2	1.00 E+0	ND	1.00 E+0 (ARAR)
Isopropene ^d	2.05 E+2		9.00 E+1	ND	9.00 E+1 (ARAR)
Benzo(a)anthracene ^d	1.00 E+2		3.30 E-1	ND	3.30 E-1 (ARAR)
Benzo(a)pyrene ^d	3.60 E+2		3.30 E-1	ND	3.30 E-1 (ARAR)
Benzo(b)fluoranthene ^d	1.80 E+2		3.30 E-1	ND	3.30 E-1 (ARAR)
Benzo(k)fluoranthene ^d	8.30 E+1		3.30 E-1	ND	3.30 E-1 (ARAR)
Chrysene ^d	2.00 E+2		3.30 E-1	ND	3.30 E-1 (ARAR)
Dibenz(a,h)anthracene ^d	7.90 E+2		3.30 E-1	ND	3.30 E-1 (ARAR)
Indeno(1,2,3-cd)pyrene ^d	6.90 E+2		3.30 E-1	ND	3.30 E-1 (ARAR)

Notes:

- * The current concentration of TCs in surface soil within the currently active area of the site appear as normal text; those of TCs in surface soil outside the currently active area appear as shaded text. The risk-based concentration and the current concentration outside of the currently fenced area are not presented for contaminants whose current concentrations do not pose a significant risk
- ^a In the concentration columns, "1.19 E+3" indicates 1.19×10^3 ; "1.14 E+0" indicates 1.14; "1.46 E-1" indicates 1.46×10^{-1} , and so on.
- ^c Not detected (ND)
- ^d Contaminant does not pose a significant risk, but its current concentration violates ARAR

TABLE 12
CLEANUP LEVELS FOR SOIL (mg/kg)

Target Contaminant (TC)	Cleanup Level
Antimony	5.00 E-1 (ARAR)
Arsenic	6.60 E+0 (Background)
Beryllium	6.00 E-1 (Background)
Chromium	
Lead	5.00 E+2 (ARAR)
BEHP	3.30 E-1 (ARAR)
DDD	
DDT	
NNDPA	3.30 E-1 (ARAR)
PCBs	1.00 E+0 (ARAR)
Isopropene ⁴	9.00 E+1 (ARAR)
Benzo(a)anthracene ⁴	3.30 E-1 (ARAR)
Benzo(a)pyrene ⁴	3.30 E-1 (ARAR)
Benzo(b)fluoranthene ⁴	3.30 E-1 (ARAR)
Benzo(k)fluoranthene ⁴	3.30 E-1 (ARAR)
Chrysene ⁴	3.30 E-1 (ARAR)
Dibenzo(a,h)anthracene ⁴	3.30 E-1 (ARAR)
Indeno(1,2,3-cd)pyrene ⁴	3.30 E-1 (ARAR)

Notes:

- The current concentration of TCs in surface soil within the currently active area of the site appear as normal text; those of TCs in surface soil outside the currently active area appear as shaded text. The risk-based concentration and the current concentration outside of the currently fenced area are not presented for contaminants whose current concentrations do not pose a significant risk
- In the concentration columns, "1.19 E+3" indicates 1.19×10^3 ; "1.14 E+0" indicates 1.14; "1.46 E-1" indicates 1.46×10^{-1} , and so on.
- Not detected (ND)
- Contaminant does not pose a significant risk, but its current concentration violates ARAR

Table 13 lists the representative chemicals found in the groundwater and the corresponding federal and state preliminary clean-up criteria that the U.S. EPA believes to be adequately protective of human health and the environment. Table 14 lists the groundwater remediation standards for the H. Brown site.

Current concentrations of individual contaminants in each aquifer were compared first with their background and ARAR-based allowable concentrations. The cleanup level for a contaminant in an aquifer is not proposed if its current concentration in the aquifer is lower than its background concentration in the aquifer or its ARAR-based allowable concentration. However, if the current concentration of a contaminant in an aquifer is higher than its background and ARAR-based allowable concentration, the cleanup level for the contaminant is set at the larger of the background and ARAR-based allowable concentrations. If the ARAR-based allowable concentration was not available for a contaminant, its current concentration in the aquifer is compared with its background and risk-based allowable concentrations. The cleanup level for the contaminant in that aquifer is not proposed if either of these concentrations are more than the current concentration of the contaminant in the aquifer. If the current concentration of a contaminant in an aquifer is more than its background or risk-based allowable concentrations, the cleanup level for the contaminant in that aquifer is set at the larger of the background or the risk-based allowable concentration for the contaminant.

The U.S. EPA has determined that Type B criteria would yield groundwater clean-up standards that also provide for the protection of surface water quality, in turn protecting human health and the environment. Type B criteria will be as protective as a remedy consistent with the U.S. EPA risk assessment policy.

U.S. EPA does not consider the other provisions of Act 307 and its implementing rules identified by the State as ARAR, because they are either procedural, not more stringent, or do not establish cleanup standards. Additionally, U.S. EPA believes that even if certain of these provisions were considered as ARAR, the remedial actions and cleanup standards selected for this site are in compliance with these state-identified ARARs since they have been selected in accordance with CERCLA and the NCP.

Michigan Water Resources Commission Act (Act 245) as amended - Portions of the Water Resources Commission

TABLE 13

**COMPARISON OF CLEANUP LEVELS FOR GROUND WATER WITH CURRENT,
RISK-BASED, ARAR-BASED, AND BACKGROUND CONCENTRATIONS^a OF TCs (µg/L)**

Contaminant	Current	Risk-based	ARAR-based	Background	Cleanup	Contaminant	Current	Risk-based	ARAR-based	Background	Cleanup
Antimony	6.27 E+1	2.00 E+0	5.00 E+0		5.00 E+0	Vanadium ^c	7.97 E+1			6.81 E+1	6.81 E+1
Arsenic	6.41 E+1			1.79 E+1	1.79 E+1		3.17 E+1	1.00 E+1	2.00 E+1	3.82 E+1	
	5.27 E+1	1.25 E+0	1.79 E+1	2.76 E+1			7.30 E+0				
Barium	3.24 E+0					Zinc	7.82 E+3			4.67 E+3	4.67 E+3
	7.34 E+2			1.06 E+3			1.61 E+2	2.50 E+2	4.67 E+3	3.09 E+3	
	4.23 E+2	1.00 E+2	2.00 E+3	4.78 E+2			2.31 E+3			1.06 E+2	
Beryllium ^b	6.78 E+1			2.76 E+1		Benzene ^b	1.01 E+1	5.00 E-1	1.00 E+0		1.00 E+0
	1.47 E+0	1.00 E-3	3.50 E+1	1.00 E+0		Benzo(a)anthracene ^d	1.50 E+1		5.00 E+0		5.00 E+0
	1.90 E+0			5.00 E+0		Benzo(a)pyrene ^d	1.90 E+1		5.00 E+0		5.00 E+0
Cadmium ^b	6.66 E+0	1.00 E+0	4.00 E+0		4.00 E+0	Benzo(b)fluoranthene ^d	2.40 E+1		5.00 E+0		5.00 E+0
	8.00 E+0					Benzo(k)fluoranthene ^d	1.60 E+1		5.00 E+0		5.00 E+0
						BEHP ^{c,d}	3.10 E+1	2.00 E-1	5.00 E+0		5.00 E+0
Chromium	8.65 E+1	6.25 E+0	5.00 E+1	9.54 E+1		Chrysene ^d	6.10 E+1				
	2.69 E+1			9.65 E+1			1.40 E+1		5.00 E+0		5.00 E+0
							6.00 E+0		5.00 E+0		5.00 E+0
Lead	3.48 E+3	Below Detection	5.00 E+0	1.42 E+3	1.42 E+3	Dieldrin ^d	7.00 E-1	5.00 E-4	1.00 E-2		1.00 E-2
	7.74 E+1			1.80 E+2		Heptachlor ^d	8.00 E-2	2.00 E-3	1.00 E-2		1.00 E-2
	8.60 E+0			1.50 E+0		Indeno(1,2,3-cd)pyrene ^d	1.90 E+1		5.00 E+0		5.00 E+0
Manganese	2.49 E+3			2.35 E+3		Phenanthrene ^d	7.00 E+0		5.00 E+0		5.00 E+0
	1.26 E+3	1.25 E+2	2.35 E+3	1.13 E+3		Vinyl Chloride	6.42 E+0	1.00 E-2	1.00 E+0		1.00 E+0
	3.20 E+2			2.16 E+1							
Nickel	4.47 E+2	2.50 E+0	1.03 E+2	1.03 E+2	1.03 E+2						
	4.91 E+1			6.70 E+1							

Notes: ^a In concentration columns, "1.05 E+1" indicates 1.05 x 10¹; "1.80 E+0" indicates 1.80; "5.00 E-1" indicates 5.00 x 10⁻¹, and so on. The information related to contaminants in shallow, intermediate, and deep (bed rock) aquifers appears in the table as normal, shaded, and bold text. A blank cell in the column for allowable concentrations based on risk indicates that the contaminant does not pose significant health risks; in the column for allowable concentrations based on ARARs, a blank cell indicates that an ARAR-based allowable concentration is not available for the contaminant; in the column for background concentrations, it indicates that the contaminant was not detected in the background; and, in the column for the cleanup levels, a blank cell indicates that the cleanup for the contaminant is not proposed.

^b Contaminant was detected only once in the intermediate aquifer

^c Contaminant was detected only once in the deep aquifer

^d Contaminant was detected only once in the shallow aquifer

TABLE 14

CLEANUP LEVELS FOR GROUND WATER ($\mu\text{g/L}$)

Contaminant	Cleanup	Contaminant	Cleanup
Antimony	5.00 E+0	Vanadium	6.81 E+1
Arsenic	1.79 E+1		4.67 E+3
Barium		Zinc	
		Benzene	1.00 E+0
Beryllium		Benzo(a)anthracene	5.00 E+0
		Benzo(a)pyrene	5.00 E+0
Cadmium	4.00 E+0	Benzo(b)fluoranthene	5.00 E+0
		Benzo(k)fluoranthene	5.00 E+0
Chromium		BEHP	5.00 E+0
		Chrysene	5.00 E+0
Lead	1.42 E+3	Dibenz(a,h)anthracene	5.00 E+0
		Dieldrin	1.00 E-2
		Heptachlor	1.00 E-2
Manganese		Indeno(1,2,3-cd)pyrene	5.00 E+0
		Phenanthrene	5.00 E+0
Nickel	1.03 E+2	Vinyl Chloride	1.00 E+0

Notes: * In concentration columns, "1.05 E+1" indicates 1.05×10^1 ; "1.80 E+0" indicates 1.80; "5.00 E-1" indicates 5.00×10^{-1} , and so on. The information related to contaminants in shallow, intermediate, and deep (bed rock) aquifers appears in the table as normal, shaded, and bold text. A blank cell in the column for allowable concentrations based on risk indicates that the contaminant does not pose significant health risks; in the column for allowable concentrations based on ARARs, a blank cell indicates that an ARAR-based allowable concentration is not available for the contaminant; in the column for background concentrations, it indicates that the contaminant was not detected in the background; and, in the column for the cleanup levels, a blank cell indicates that the cleanup for the contaminant is not proposed.

^b Contaminant was detected only once in the intermediate aquifer

^c Contaminant was detected only once in the deep aquifer

^d Contaminant was detected only once in the shallow aquifer

Act 245 (Michigan Act 245) of 1929, as amended, will be applicable to the remedy and establish surface water-quality standards to protect human health and the environment. The State administers the NPDES program under Part 21 of Michigan Act 245; therefore, Part 21 of Act 245 would be applicable to the direct discharge of treated water to the Grand River.

Michigan Air Pollution Act 348 provides air emission requirements for actions which may release contaminants into the air. The selected remedy involves excavation, construction, and groundwater treatment activities which may release contaminants or particulates into the air. This act is relevant and appropriate.

2. Location-specific ARARS

Location-specific ARARS are those requirements that relate to the geographical position of a site. These include:

Federal ARARS

The Clean Water Act Section 404 - This section of the Act regulates the discharge of dredge and fill materials at sites to waters of the United States. These regulations are applicable to capping of the site and other activities which may take place in the wetlands.

Wetlands Management Executive Order 11990 - This order is applicable to the site. The order requires federal agencies to avoid, to the extent possible, the long- and short-term adverse impacts associated with the destruction or modification of wetlands.

RCRA Location Standards 40 CFR Part 264.18 - These standards are relevant and appropriate for the remedy at the H. Brown site because a portion of the site is located in the 500 year flood plain. These standards specify that a facility located in a flood plain must be designed, constructed, operated, and maintained to prevent washout of hazardous wastes by a flood.

Floodplain Management Executive Order 11988 - This order is applicable at this site. It requires the minimization of potential harm to or within flood plains and the avoidance of long- and short-term adverse impacts associated with the occupancy and modification of flood plains.

State ARARs

Goemnere-Anderson Wetland Protection Act, Act 203 of 1979 - Regulates any activity which may take place within wetlands in the State of Michigan. Act 203 is applicable at this site; it will require the replacement of adversely impacted wetlands with comparable resources.

Soil Erosion and Sedimentation Control Act, Act 347 of 1972 - This act is applicable to this site due to the selected remedy's use of construction activities that may impact the Grand River. The act regulates earth changes, including cut and fill activities which may contribute to soil erosion and sedimentation of surface water of the State. Act 347 would apply to any such activity where more than one acre of land is affected or regulated action occurs within 500 feet of a lake or stream.

Michigan Act 307, Rule 719(3) - This rule requires institutional controls be placed on the site including, but not limited to, notice to future property owners of contamination at the site, deed restrictions to regulate the development of the H. Brown site, and groundwater use restrictions in the areas that have contaminated groundwater. Groundwater use restrictions may be rescinded after remediation standards are met and proven to be maintained.

3. Action Specific ARARs

Action-specific ARARs are requirements that define acceptable treatment and disposal procedures for hazardous substances.

Federal ARARs

RCRA Subtitle C Land Disposal Restrictions (LDRs) - Consolidation and solidification/stabilization will occur within the area of contamination. Therefore, the requirements of this act will not be triggered for solidification/stabilization. The requirements of this act will be applicable to any off-site treatment of the waste products of the selected remedy due to the groundwater treatment process and required pretreatment steps, and to any of the waste products of that process that are RCRA hazardous waste. These regulations govern the storage and disposal of hazardous waste. This remedy will comply with LDRs through a Treatability Variance for wastes that cannot be treated to meet the standard.

State ARARs

Michigan Hazardous Waste Management Act (Act 64)- Upon closure of the site, high levels of contaminants will be left on-site in a solidified/stabilized mass. Because the solidified/stabilized waste is sufficiently similar to waste regulated under the Act and there is a need to protect the solidified/stabilized mass from seasonal conditions, the Act's requirements are relevant and appropriate for the waste.

Michigan Public Health Code, Public Act 368 of 1978, Part 127 - This act regulates the water supply intended for use or used to supply groundwater. It is applicable to the selected remedy, because it addresses the location, construction, and abandonment of private drinking wells.

Inland Lakes and Streams Act, Public Act 346 of 1972, as amended - The act regulates construction activities on or over bottomlands of inland lake and streams. This act will be applicable to the selected remedy, because it addresses the mitigation of potential run-off, erosion, silting, and sedimentation in the surface waters during construction.

Mineral Well Act, Public Act 315 of 1969, as amended - This act regulates location, construction, and abandonment of monitoring and test wells. This act is similarly relevant and appropriate for the selected remedy.

4. To-Be-Considered ARARs

OSWER Directive #9355.4-02 Interim Guidance on Establishing Soil Lead Cleanup Levels at Superfund sites - This directive sets interim soil lead cleanup standards at 500 - 1000 parts per million.

c. Cost Effectiveness

Cost effectiveness compares the effectiveness of an alternative in proportion to its cost of providing environmental benefits. Table 14 lists the costs associated with the implementation of the remedies.

The selected remedy for management of migration, Alternative 15, has been determined to afford overall effectiveness proportional to its cost. Alternative 15 carries moderate costs in comparison to the other nine alternatives considered. Those alternatives less costly than Alternative 15 do not offer permanent solutions such as the

solidification/stabilization proposed in Alternative 15. They instead propose to contain the waste without treatment. The selected remedy, therefore, affords the greatest effectiveness proportional to its cost.

d. Utilization of Permanent Solutions and Alternative Treatment Technologies or Resource Recovery Technologies to the Maximum Extent Practicable

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost effective manner for this site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the U.S. EPA has determined that the selected remedy provides the best trade-offs in terms of long-term effectiveness and permanence, reduction in toxicity, mobility, or volume achieved through treatment, short-term effectiveness, implementability, cost, and considering state and community acceptance.

The selected remedy offers a high degree of long-term effectiveness and permanence. It will significantly reduce the inherent hazards posed by the contaminated soil and groundwater by treating these substances. These benefits are achieved at a reasonable cost.

e. Preference for Treatment as a Principal Element

The statutory preference for treatment as a principal element of a remedy is satisfied by the selected alternative.

12. SUMMARY

The presence of soil and groundwater contamination at and around the H. Brown site requires that remedial actions be implemented to reduce the risk to public health and the environment. The U.S. EPA believes, based upon the RI/FS and the Administrative Record, that the selected alternatives provide the best balance of trade-offs among alternatives with respect to the criteria used to evaluate the remedies. Based upon the information available, at this time, the U.S. EPA believes that the selected remedy will be protective of human health and the environment, will attain ARARs and will utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable.

ex

The total estimated costs for the selected remedy at this site are as follows:

<u>Alternative</u>	<u>Total Capital Cost</u>	<u>Total O&M, 30 yr.</u>	<u>Total Present Worth</u>
15	13,000,000	220,000	15,000,000

Responsiveness Summary

U.S. Environmental Protection Agency
Region 5, Library (PL-12J)
77 West Jackson Boulevard, 12th Floor
Chicago, IL 60604-3590